

June 19, 1961

Aviation Week

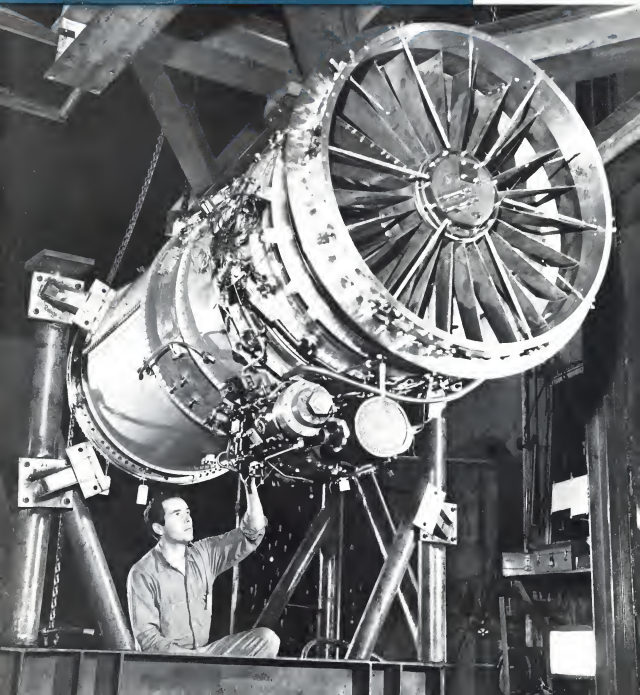
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Designs Studied
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Orbital Vehicles

Pratt & Whitney JT8D-1
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GOOD YEAR

ELECTRONICS: Another Prime Capability of Goodyear Aircraft



RE. Electronic test and diagnostic equipment, for the Control Programmer and Analyzer, being equipped in the new test production line in Long Beach.

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Do you have a problem finding electronic test and checkout equipment that will meet your 2000-hr. requirement? The Control Programmer and Analyzer (CPE) made by Goodyear Aircraft Corporation (GAC) may well be the fastest, most economical solution you can find.

ITEM: A typical CPE costs only \$45,000—many thousands of dollars less than other equipment in its field. (In fact, it is a class by itself.)

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now X marks
our spot



XEROX
CORPORATION

On June 1 the name of our company changed from Haloid Xerox Inc. to Xerox Corporation. Therefore, you will want to bring your reference files up-to-date. Then, when you're looking for information on office copiers, high-speed continuous printers and other reproduction equipment, you will find it—under "X." ■ Why this curious name "Xerox"? The word is of classic origin and stems from the Greek *xeros*, meaning "dry." And why do scribers, perhaps as well as one word can, the revolutionary process on which our copiers and printers operate. ■ The initial

"X" in all English words of ancient Greek origin is pronounced as a "Z." Hence, Xerox is pronounced *zairax*... but here we part company with all things ancient and Greek. ■ For the Xerox in our new corporate name stands for a modern, progressive, research oriented company which, through exciting new products, is making its mark in the growing field of graphic communications. ■ In meeting the needs of readers business for better ways to record, condense, store, and recall the sheer mass of information, Xerox Corporation helps management to manage the future. For more information on our company, write Xerox Corporation, 20 Haloid Street, Rochester 3, New York.

AVIATION CALENDAR

- June 26-28—**19th National Convention on Military Electronics**, Institute of Radio Engineers, Sheraton Hotel, Washington.
- June 28—**2nd European Symposium on Space Technology**, British Interplanetary Society, London, England.
- June 28-29—**Special Technical Conference**, American Institute of Electrical Engineers, Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.
- June 27-28—**International Symposium on Analytical Aerodynamics**, Santa Barbara, Calif. (Contact: Capt. J. E. Collett, Air Force Office of Scientific Research, Washington 25, D. C.).
- June 27-28—**Airline Operations Conference**, Sir Thompson, Inc., Wagon Wheel Lodge, Durham, N.C.
- June 28-29—**Summertime Space and High Altitude Rocket Testing Symposium**, Arnold Engineering Development Center, Tullahoma, Tenn. (Scheduled).
- June 28-30—**Joint Automatic Control Conference**, University of Colorado, Boulder.
- June 28-July 1—**Annual Meeting**, Institute of Navigation, Williamsburg, Va.
- July 1-12—**19th Annual All-Woman Texas Instrument Air Race**, San Diego, Calif. (Contact: City, N. J.).
- July 10-15—**Third Annual Industry Metals and Space Conference and Aerospace Exposition**, Michigan Automobile and Space Race, Cobo Hall, Detroit, Mich.
- July 10-11—**Fourth International Conference on the Medical Environment**, Institute of Radio Engineers, Waldorf Astoria, New York, N. Y.

(Continued on page 6)

AVIATION WEEK and Space Technology

June 19, 1961
Vol. 24, No. 21

AVIATION WEEK and Space Technology is a leading authority on the latest developments in the field of aviation and space technology. It is a must-read for all those concerned with the progress of these two fields. The magazine covers a wide range of topics, from the latest in aircraft design and development to the latest in space exploration and satellite technology. It is a comprehensive source of information for all those interested in the future of flight.

For more information, write to: AVIATION WEEK and Space Technology, 1000 Pennsylvania Avenue, N.W., Washington, D.C. 20004.

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AVIATION WEEK, June 19, 1961

SOLID RIVET STRENGTH WITH BLIND RIVETS

**CHERRYLOCK RIVETS for Your
Difficult Solid Rivet Applications**

BULBED CHERRYLOCK

**ONLY THE BULBED CHERRYLOCK RIVET
GIVES YOU ALL THESE ADVANTAGES**

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Blind Side Clearance • Positive Visual
Inspection (Grip Length Marked on Head)



Ideal for Thin Sheet and
Double-Clamp Applications—
extremely large blind head

A-306 STAINLESS STEEL • MONEL • ALUMINUM

The Bulbed Cherrylock offers a blind rivet that installs and performs like a solid rivet. Bulbed Cherrylock Rivets will qualify where you are now using solid rivets, offering higher joint strength with greatly increased joint reliability under critical loading conditions—fatigue, shock and cyclic vibration.

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Now: a complete nationwide support program for the Cessna CH-1C. Furthering an idea pioneered by Cessna for its U-3A, the CH-1C now becomes the first rotary-wing aircraft in history to offer the military the proved economies of complete off-the-shelf logistics support. As with the U-3A, support of the CH-1C can be in with world-wide support of its commercial counterpart (Skyhawk) and be carried out by designated Cessna dealers across America. Now the Cessna CH-1C can make rotary-wing flight for the military practical as never before.



World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(Continued from page 5)

- July 17—Air Force Contract Aviation Symposium, National Aeronautics Services Assn., Hanoi Washington, Washington, D. C.
- July 18—Quantity Regional Meeting Assn. of Local Transport Airlines, Crow Field Inn, Asheville, N. C.
- July 24—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.
- July 25—Air Transportation Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.
- July 26-28—Aerial Convention, Southland Air Association, Santa Ana, Orange, Calif.
- July 28-Aug. 1—Conference on Physics of the Solid State and Its Applications, For information write: Conference Director, Room 310, Hayden Hall, Virginia Polytechnic Institute, Blacksburg, Va.
- Aug. 1-4—Fourth Western Regional Meeting, American Astronautical Society, Sheraton Hotel, San Francisco, Calif.
- Aug. 24—Symposium Meeting on Airframe Applications for Helicopters, Third U.S. National Aerospace Society for Testing Materials Santa Ana Inn, Pacific Park Hotel, Santa Ana, Calif.
- Aug. 29—Cardiac and Neurological Conference, American Society, Stanford University, Palo Alto, Calif.
- Aug. 31—Cognitive Engineering Conference, University of Michigan, Ann Arbor, Mich.
- Aug. 30-31—International Hypersonic Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.
- Aug. 19-24—Institute of the Aerospace Sciences/NASA Symposium, San Diego, Calif. (Continued)
- Aug. 22-24—Western Electronic Show and Convention, Cow Palace, San Francisco, Calif.
- Aug. 24-26—South Atlantic National Exposition, DFB Club of America, Silver Hotel, Winston, N.C.
- Aug. 26-Sept. 1—Third Annual Symposium for Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Anaheim Hotel, Los Angeles, Calif.
- Sept. 4-10—1967 Third Display and Exhibition Society of British Aircraft Corporation, Farnborough, England.
- Sept. 4-10—Sixth Anglo-American Naval Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, London, England.
- Sept. 10-12—National Aerospace Symposium, Wright-Patterson Air Force Base, Dayton, Ohio.
- Sept. 10-12—National Symposium on Space Electronics and Telecommunications, University of Mexico, Alameda, Mexico.
- Sept. 13-15—National Symposium, National Aeronautics Assn., Washington, D. C.
- Sept. 20-24—National Convention and Airframe Exposition, Air Force Assn., Philadelphia, Pa.
- Oct. 1-7—24th International Astronautical Congress, Washington, D. C.
- Oct. 8-10—American Rocket Society's 10th Annual Meeting & Space Flight Report to the Public, Columbia New York, N. Y.
- Oct. 14-22—Federation Aeronautique Internationale 1967, General Conference, Hotel D'Orleans, Rio de Janeiro, Brazil.

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Reliable Harrison Heat Exchangers Control Engine Oil Temperatures of New Twin-Engine G6BF Executive Plane

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This and other approaches to aerospace deceleration are now being studied and evaluated at Northrop's Radioplane Division as part of its comprehensive program in landing and recovery systems. Long recognized

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hard gold mating against soft gold adding durability and minimizing galling. An exclusive wire-seat promoter will seal all required wires and in addition type EE, MJ, W 1463E. Electrically, mechanically, BANTAM connectors have proven completely dependable. Copper alloy crimped entry sockets, extra heavily gold plated over silver . . . moisture proof resistant inserts . . . cadmium plated shells of injection-molded aluminum . . . heavy spring tension for perfect interface sealing.

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for
missile
reliability

Yard but vulnerable inside components must "live" in severe aerospace environments. This requirement is being met with protection afforded by Lord-engineered mounting systems.

Vibration/shock/noise control, now employed on the missiles above, is a proved route to increased reliability. Lord suspensions have been an essential factor in reaching a high plateau of performance for several critical programs.

Many types of advanced "soft mounting" systems, both elastomeric and non-elastomeric, have been custom designed. As a result, guidance systems perform with enough precision. Sensitive GSE units are transported safely. Electronic equipment operates reliably on low-vibration, damped shocks.

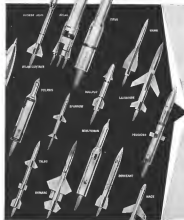
Alert missile designers have come to rely on Lord to help them reach higher reliability levels. A call to the nearest Lord Field Engineering Office or the Home Office, Erie, Pa., will put you in touch with those responsible for the important advances in vibration/shock/noise control.

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the ones
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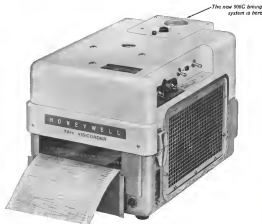
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They have not changed since 1936, when the Visicorder principle of oscillography made accurate records of high frequency data possible for the first time.

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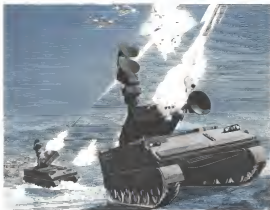
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Naval Aviation was launched 50 years ago with the first round-trip flight from a naval vessel. The route was January 18, 1911. The plane was Sea Sparrow Bay Eagle. It took off and landed a Curtiss biplane from a wooden platform especially constructed on the cruiser U.S.S. Pennsylvania. Its top speed was 50 knots. Today, powerful jet fighters, such as the McDonnell F-4H Phantom II, are routinely catapulted by some catapults

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Del Mar whets the officers and men of Naval Aviation who, down through the years, have steadily mastered their operational readiness to face any world crisis.

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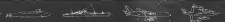


INTERNATIONAL AIRPORT
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For information on this system, contact: Del Mar Engineering Laboratories, Inc., 4000 Harbor Blvd., Del Mar, Calif. 92014.

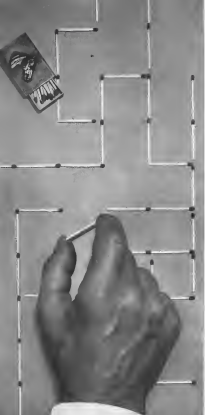


Once off the firm footing of earth, the most critical need of any vehicle is for precise *direction*. The straight course of a sub, a ship, a jet... the precision track of missile or space vehicle... these result from a directional reference of superior accuracy; the kind provided by gyros made at Sperry. Whatever the application, gyros by Sperry have a common denominator: stability. Sperry is dedicated to, concentrates upon, stability – absolute directional accuracy, absolute repeatability. The result is seen in the widespread technological successes achieved at the direction of the Sperry gyroscope. General offices: Great Neck, N.Y.



Sperry gyros are the precise directional reference in land and many other applications: precision navigation for the Polaris sub, weapons guidance for advanced weapons such as the H-5 Sparrow missile. Right gyros for the C-119 gun ship control, precision inertial guidance for the B-52 "Stratofortress", mid-airway "gyro" for space vehicles (operational) and other (under development).

SPERRY



He designed a new interchange for radio traffic

Then AMF engineer, part of an AMF-U.S. Army team, solved the problem of traffic delays and personnel danger in manual retransmission of messages when interchanging V.F. transmitters and antennas.

This solution is a push-button-operated, contactless switching system, using vacuum switches for circuit selection. A typical system consists of 4 transmitter inputs, 7 antenna outputs plus a dummy load, in a 4x8 matrix that can be mounted in a 19" rack. It can be controlled locally or remotely over any type of communications network having 4 bandwidths of at least 300 cycles.

AMF's manual antenna relaying system provides 100% flexibility in circuit path selection and accommodates power levels as high as 500,000 watts and frequencies up to 30 megacycles. It allows 100% utilization of all transmitting equipment. Switches are automatically eliminated.

To insure fail-safe operation, power is required for the vacuum switches only during change of condition. Selection cycle is 1 per second. Operating transmitters are safety-interlocked to ensure a load. There are no hazards from open wires or inadvertent application of power to dead load antennas.

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- Radar Systems
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AMERICAN MACHINE & FOUNDRY COMPANY

Aviation Week and Space Technology

June 19, 1961

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Number AEP and JEC

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Our Best Foot Forward

At the dawn of the cold war era deeper, it became increasingly obvious that the United States must devote considerable thought and energy to projecting a realistic range of its strength, vitality and determination to maintain its basic concepts for friends, foes and neutrals to see and believe. At long as we had a national leadership with the philosophy of an aging has-youthful champion of the world, having to retire undisturbed and ignoring the challenges of any new contenders as rather low vigilance and diagnosis, this type of usage was difficult to project ahead.

In fact, this philosophy contributed substantially to the misperception, still current in many parts of Europe, Africa and Asia, of the United States as a currently preoccupied nation too fiscal and complacent to defend and maintain its position in the world—equally indifferent to the welfare of its friends and the defeat of its enemies.

Fortunately, President Kennedy, from his inaugural address onward, has sought to change this image and confirm the vitality of a still young nation determined to meet the challenges of the times and confident of its ultimate success despite the harassment of temporary failures. In the effort to project this type of usage, the aerospace field must play a key role. For it is the only place where new technologies of the aerospace frontier that the world at large has found a readily acceptable standard by which to measure the relative vitality of the competing systems of the United States and the USSR.

Last week, we emphasized the transcendent aspect that our full technical participation, both with men and machines, in the Paris International Air Show produced on the European continent. There also have been other significant activities in this area that are adding to this constructive effort and should be strongly commended and contrasted.

One of these is the well organized insight on world records for aircraft and helicopters that has been spearheaded by Jacques Cochran, president of the National Aeronautic Association, directed by the new NAA executive director Ralph Whitcomb and supported fully by the military services. When Vice Adm. Robert H. Price, deputy chief of naval operations for air, Maj. Gen. Richard M. Montgomery, USAF assistant vice chief of staff, and Brig. Gen. Clinton von Kann, director of Army aviation. For a number of years, Defense Department policy barred the use of our best military aircraft for world record attempts and left the field largely to British, French and Russian competitors.

By the middle of last year, the Soviets had captured 106 official world helicopter and aircraft records in contrast to 98 held by the United States. Thanks to the new leadership of NAA, backed by full cooperation of the aerospace industry and the military services, the scoreboard now stands at 115 records held by the United States and 101 held by the Soviets. The United States has captured 27 world records since January and has 15 more attempts scheduled to swell this total in the next few months.

The fact that many of these records were captured from the Soviets has not been lost on the rest of the world. The respectability of these record performances, both the spectacular absolute speed altitude and climb

records made and the close month with periods, is best attested by the Soviet efforts to capture the U. S. records and return these records to the USSR. Contrary to the common opinion of some amateur military experts "experts," these record performances do not disclose the significant military performance parameters of these records.

Not even more significant than the determined effort to prove by performance the technical superiority of our aerospace equipment is the open manner in which these records are established and documented. For it is in the contrast, between U. S. willingness to authenticate and document its performance skills with international observers who required and the Soviets' traditional secrecy that even refuses to show a picture of its alleged record-breaking aircraft, that the basic difference between the two ways of life are becoming clearly apparent all around the world.

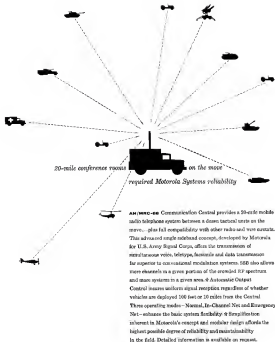
When Col. Alan Shepard made his first Mercury space flight from Cape Canaveral, Jacques Alain, president of the Fédération Aéronautique Internationale, was in the blockhouse at Cape Canaveral observing the instrumentation to authenticate any U. S. claim for space flight records, which have since been submitted to the FAI for homologation. When the FAI met in Paris a few weeks ago, the Soviet delegates were acutely embarrassed by their inability to offer similar opportunities to the U. S. allies. These puzzled statements that they thought they might be able to set "something" of the Soviet space flight records hardly improved either the FAI president or the other international delegates.

Another contrast was provided by the Paris Air Show, where the top U. S. record holding aircraft and helicopters were in static and flying display while the Soviets did not even display a picture of any of their aircraft, for which they have submitted several claims under phony designations such as the "Y-66 monoplane," etc.

The proposed American Rocket Society "Space Flight Report to the Nation" scheduled for New York in October, with its strong attractions for international attention, is one right display in the right direction. The invitation to Soviet space scientists to participate in the event should provide another striking contrast between the free interchange of scientific information on the role of the free nations and the type of secrecy behind it that can only be interpreted by the rest of the world as a rejection of scientific and a lack of ability to compete truly and openly with the free world.

It is more that at this late date it should be necessary to laud the leadership of a nation that give to its present stature through tough competition with all comers in all fields on the importance of continuing to compete internationally in the vital technologies of our times. Even the relatively small efforts made since January in free discussion have already paid rich dividends if they are encouraged and continued. The Soviets will find themselves lost, pressed to competing their current international record of scientific and military parity or superiority, and the true winners of these two competing systems should be readily apparent for the whole world to see.

—Robert Hous



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WHO'S WHERE

In the Front Office

J. T. Lathrop, head chairman of Hawker Aircraft Ltd., according to Roy Dobson, vice chairman of the Hawker Siddeley Corp., who will remain on the board. Sir Sydney Camm, (age 71) chief executive succeeds Mr. Lathrop as managing director. Other Hawker board appointments: R. L. Lathrop, deputy managing director; E. G. Robinson, general manager; W. J. Harrison, secretary. Mr. Lathrop also succeeds Sir Roy as chairman of Folland Aircraft Ltd. and Mr. Lathrop succeeds Mr. Lal as managing director.

Harold D. Eide, a director of Folland Research Corp., Whiston, Md. Mr. Eide is chairman of Jucker & Boley, a director of Helms Research Corp.

General Dynamics Corp., New York, N. Y., has approved the following as vice presidents in new new divisions (age 59): of the corporation General Dynamics/Astronautics-Victor E. Knudsen (also vice president), Wilbur W. Wolfe (research and engineering), Harold D. Beards (operations), General Dynamics/Curtis-F. H. Farnes (development), E. K. Peterson (engineering), General Dynamics/Pennsylvania-D. D. Farnes, Jr. (research and development), G. E. Sylvester (operations), General Dynamics/Work-Robert H. Wild (research and engineering), R. G. Reed (operations).

Sam W. Cahill, vice president machine tooling, Helms Manufacturing Co., New York, N. Y.

Roger Brown, executive vice president, Cannon Electric Co., Los Angeles, Calif. Donald G. Fink, vice president research, Paces Corp., Philadelphia, Pa.

Edith G. Romanus, vice president, Edco Corp., College Park, Md. Mr. Romanus will succeed Archibald M. Brown, Edco's vice president who upon his resignation on Aug. 5, Mr. Brown continues in a director of Edco and as president of Edco Canada Ltd.

Mr. H. H. Whitham, vice president for administration, United Air Lines, Inc. Also D. T. Latham, vice president transportation services for Western operations (with local quarters in Denver), Field A. Brown, assistant vice president and general manager transportation services for Eastern operations (with headquarters in Washington, D.C.). R. W. Shadley has been named the assistant general manager transportation, D.C.

W. T. Noll a director and vice president Minneapolis-Honeywell Regulator Co. Mr. Noll is general manager of the company's Armstrong Division located in Minneapolis and Los Angeles.

Robert F. Hunt, vice president operations Grand Central Station Co., Redwood, Calif. Arthur L. Chapman, senior vice president, Pacific Mercury Electronics, Redwood, Calif.

Arthur G. Bels, as assistant vice president, Robertshaw Fabrics Controls Co., Richmond, Va., and general manager of that company's Business Research Center, King of Prussia Pa.

Marion J. Stock, controller, Solar Aircraft Co., San Diego, Calif.

(Continued on p. 126)

INDUSTRY OBSERVER

► Raytheon has been selected to handle research and development for advanced Research Projects Agency's new terminal defense against ballistic missiles, called ARPA Terminal or ARPAT (AW May 12, p. 19). Raytheon also includes Hughes Aircraft, which will be responsible for the interceptor vehicle, Boeing and IBM's Federal Systems Division. Initial contract will be for about \$5 million.

► An F-4 is expected to add its role as its large solid propellant booster in short run work. Engines will have to produce 30,000 lb. of thrust for 50-100 sec., and as much as seven sec. be classified as a booster stage. Requirements are expected to specify segmented engines but may leave the question of central vs. cylindrical segments up to the bidder.

► Orbit of Venus and return to earth is one spacecraft mission for the proposed manned, 350-410 high Nova space launch vehicle. Three upper stages for this configuration are a single Rockwell J-2, an Pratt & Whitney LR-113 and a Thieme-Hydraspace engine.

► Army and Navy both plan to insert in further development of the Lockheed real-time helicopter design which was named up in the light observation helicopter competition. Lockheed has been firing a prototype which obtains directional movement by changing the angle of the fuselage when the rotor shaft is mounted on the fuselage. Left is controlled by varying engine speed. The design reportedly offers inherent stability and saving of more than 20% both in original cost and maintenance cost.

► French and West German governments have ordered six pre-production models of the Transal range aircraft which is being developed jointly by French and German companies. First flight of the military transport powered by two Rolls-Royce Tyne turbojets, is scheduled for July, 1962. For prototypes were ordered initially, including two for strike during French and German defense exercises together expect to order about 150 aircraft.

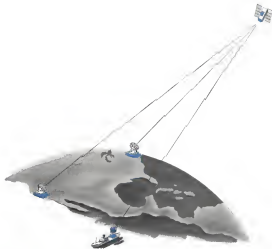
► First model of Grumman's DSN-1 DASH three subsonic helicopter, which will be the operational design, flew Apr. 5, and delivery to the Navy is expected next month. Earlier models were powered by a gas-turbine-fueled Pavelec automotive engine, but DSN-1 is powered by a Boeing T100-604 burning JP-5 because the Navy decided to stop all utilization of more hazardous aviation gas facilities as desirables. New models of the DSN-1 which has subsonic speed with 1400 hp (13, p. 113), were built, of which four crashed. Three DSN-2s were built.

► Electrojet's turbojet will be tested on Nimbus II and subsequent aircraft until under the present plan. The type series was discontinued from Nimbus I because development is not expected to be completed in time for a mid-1962 launch. RCA has built an operating brand-new model of the series.

► Success of Northrop's booster layer control research will be a key to the decision on developing a subsonic, long-endurance Deacon-type booster instead of the Mach 1.8 (70, p. 105). Northrop work is aimed at assessing the booster layer over the wing, reducing drag and increasing endurance (AW May 28, p. 81).

► Purchase of four Scout vehicles and six satellites is covered by Navy's request for \$4.5 million in Fiscal 1962 procurement funds for its Transit experimental sea surface satellite. Previous bid cost \$54.5 million to the end of Fiscal 1961. Prototype operational design will weigh 90 lb. instead of the 210 lb. in the current experimental model and will be launched by Scout in early 1962. In addition to being lighter, the satellites will have significant increases in electrical power and satellite memory capacity.

► Portable man-made telemetry stations may be located in Ethiopia, India, Singapore, Hawaii and Guam to receive information data from the Explorer XI gamma ray telescope satellite launched Apr. 25. The power system is supplied by solar cells, and the satellite has an estimated useful life of a year.



ADVENT OF A NEW ERA IN COMMUNICATIONS will come about through the use of wide-band microwave radio repeaters in stationary satellites. Under the overall direction of the U.S. Army ADVENT Management Agency, Bendix is developing satellite repeaters and ground terminal equipment for the Army Signal Corps, and a shipboard terminal for the Navy Bureau Of Ships. This important participation in Project ADVENT exemplifies the new technical challenges and careers offered by our expanding Space Laboratory.

Qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

BENDIX SYSTEMS DIVISION

ANN ARBOR, MICHIGAN



Space Record Session

Washington Roundup

Special technical committee of the Federation Aeronautique Internationale will meet July 17 in Paris to study U.S. and Soviet claims for space records, based on the flights of Col. Alexei Leonov and Maj. Yuri Gagarin, and to make recommendations for their handling in official FAI records.

Russia submitted the claim of factual data on Gagarin's orbital flight that is required as a result of the FAI Barcelona meeting but fell but presented it in an elaborate, hand-bound leather folder. The mass of technical detail on Shepard's Mercury flight was presented in a plain manila envelope, stamped paper.

U.S. technicians on the committee will press for elaboration of some Soviet details, for example, a more precise answer on the thrust of the booster engines. All Russia said was that they produced 20 million hp.

U.S. representatives on the FAI sporting committee also will continue to press the Russians to submit pictures of records for which they claimed. The Soviet film strip that accompanied the world altitude record claim of 112,237 ft. for the R-6B shows an aircraft that looks suspiciously like the Lockheed F-104, which now holds the official record at 105,505 ft.

Soviet Russia has a delta-wing supersonic bomber in production and in operation. Three separate Soviet supersonic aircraft have been identified under way at one by the U.S. News.

Joint Chiefs of Staff will study on the detrimental effects of a continued nuclear test moratorium this week at a closed session of the Joint Congressional Atomic Energy Military Applications Subcommittee. Administration supporters in Congress are urging the President to end the voluntary ban.

Noise Effect Probe

Pressure is building for a broad congressional investigation of the effects of airports on surrounding communities. The matter gets longer runways have aggravated the problem. Focus now is on the House Rules Committee, which is considering a resolution by Rep. Richard E. Laskford directing the House Banking and Currency Housing Subcommittee to study effects of federal airport development on surrounding homes, with emphasis on the Federal Housing Administration's policy of refusing to insure mortgages in homes considered too close to airports.

Until now, House Interstate and Foreign Commerce Committee Chairman Otis Harris has refused to support special studies, preferring to keep that the province of his own committee. But one source of the Rules Committee told *Aviation Week*: "If Otis doesn't do something about this jet problem on his own committee, I'm going to have to take it to a select committee look into it."

Rep. Joseph P. Addabbo, whose district is in Long Island, said his constituents are so upset now that he is afraid to go home for the summer. "First thing you know, somebody . . . is going to shoot down one of those jets flying over his house with a shotgun," he said. "We've got to do something."

Likely result: Rep. Harris will conduct his own special investigation.

Army Col. Earl G. Prosser is the new military consultant for the House space committee, succeeding Navy Capt. Howard J. Silenstien, who leaves the post next month. Col. Prosser served in the Office of Defense Research and Engineering and worked on Army's Long Range laser studies.

AFSC Vacancies

An Air Force Systems Command has approximately 500 vacancies in its Reliability Systems and Space Systems Divisions that cannot be filled for lack of qualified personnel. This example of the current gap in technically oriented personnel was mentioned to Congress recently by Lt. Gen. Roscoe G. Wilson, USAF's deputy chief of staff for development. Gen. Wilson said "as vacancies gap" is coming in the quality of some experts, major and minor technical talent, and "in a matter of years it is going to be very difficult to find people."

Defense Department will be called before the House Armed Services Investigating Subcommittee, headed by Rep. Edward Hebert, next week to justify the authorizing out of non-profit organizations. Fiscal 1961 payments by Defense for outside services exceed \$120 million.

President's Committee on Equal Employment Opportunity is continuing to meet quietly with defense contractors in the hope of getting more equalization agreements, such as the one signed last month by Lockheed Aircraft Corp. Several companies met last week privately with committee staff members, and more will hold talks this week. Vice President Lyndon Johnson heads the committee.

—Washington Staff

Fiscal 1962 Missile and Aircraft Procurement

Congress authorized this Fiscal 1962 program last week. Funds already on hand will partially finance the Air Force and Navy aircraft programs and the Navy missile program.

[illegible]

Party	As Party Total	Party	As Party Total
ADP-1	100	Muskie placement	240.4
ADP-1	24	Spreen, III, Sadowsky, IC, Tuzio, Tuzio,	
FDH-1	30	Tyrin, Bu,app, Rajulu, I, Salome	
FDH-1	72	Wager three placements	29.1
FDH-1	46	QSC, KSC, LKH, R, I, PUF&K conversion,	
FDH-1	62	Low Jungs KIHU transfer	
FDH-1	78	ASW Anne Schopatz	8.7
FDH-1	10	Polina Kishikowski	354.4
FDH-1	46	Industrial Facilities	1.0
FDH-1	12	Anticoxants	4.8
FDH-1	14	Party Total	648.6
FDH-1	10		
Total	1,100.5	Assn	
Adverse placement	140	Medics	550.8
Adverse placement	401.1	Wile, Blomden, Brook, Budge, Shout, John,	
Adverse placement	401.1	Little John, Andrew, Smith	

USAF, Navy Criticized on Aircraft Buys

The Katherine Johnson

Washington-Air Force and Navy have been severely criticized for squandering money on programs for wounded patients of military support aircraft involving hundreds of aircraft and a total of 5,000 million-or more.

Home appropriations subcommittee members said that the services approached the program quietly in a personal basis failing to coordinate plans, and they suggested that cost factor preference was an influencing factor in the selection of awards. Appropriations subcommittee hearings on military procurement were closed but work

Rep. George Mikes (@Tels), chairman of the subcommittee, called the procedure "mismanagement at its worst" and urged the office of the secretary of defense to work out a single coordinated program "that can be defended," with particular emphasis on basic maintenance and operations. He observed to Thomas D. Morris, assistant secretary of defense for man and machine:

"If you represent that agency is the Defense Department that is supposed to coordinate procurement procedures and move toward more efficiency and economy, it seems to me here is a good place to put your foot down and decide, after conference with all the services, officially which way we move."

Air Entry Plane

An F-16's program, now pending before the secretary of defense, calls for 126 Lockheed C-140 jetties to replace obsolescent C-70s and C-47s. USAF

procurement. C-140s and C-130s were bought from C-140s in fiscal 1959 for Airways and Air Communications Services. An additional lot was ordered for procurement for executive and last December, with funds made available through apportioning and without advance notification to the congressional appropriations committee.

Two T-40C-2s were designated for the Jetties and are included in the Administration's Fiscal 1982 USAF budget. At House appropriations hearings, USAF acknowledged that fiscal 1982 aircraft would be "ordered and delivered as the C-140 type" to replace C-14As and C-14Bs.

The Navy program, now pending before the secretary of the Navy, proposes replacement of approximately 200 Douglas R4D aircraft—Navy designation for the USAF C-47—with German Condor-type types. Vice Adm. R. B. Puse, deputy chief of naval operations for air, outlined the two points to discuss in the subsequent discussion.

placement recommendation that has been made to the NAS system.

Mikesa commented that for the project, "I do not care to make a point," but a "Navy Statement on Transport Aircraft" from an unnamed source was subsequently inserted in the record. It was an evaluation listing the Coliseum over the Fordlud E-27. Adm. Pica said Navy wants to reorganize funds this summer in order to start procurement of the RAD replacement in Fiscal 1962 with a purchase of "two or three" aircraft.

According to USAF figures, the unit flying cost of the three competing types is C-148, \$1.5 million; Gulfstream, \$1.1 million; F-27, \$1 million.

In response to congressional allegations of contractor favoritism and that USAF and Navy were making and placing small orders before the overall procurement program had been officially agreed upon—"to make to improve the financial status of the producer," Lt. Gen. Mark Budinger, USAF deputy chief of staff for material, commented.

"I'm having four or five companies with very little work in them, and three or four people with a prototype or two and a small commercial order, and all of them are trying to somehow sell enough airplanes to the services to break even. I think that you will find General

ness, having been a Navy plant on the scene. The Navy authorities would tend to try to fill their requirement with their plant. Certainly the Air Force would probably feel the same way and so on all around. I think this is a problem of the services getting together. If there were plenty of airplanes, it would probably be pretty easy to settle

on one, but there aren't many airplanes
being bought.

Meanwhile, Congress completed action last week on legislation authorizing over \$9.6 billion in new funds for aircraft and missile programs. All funds asked by the Administration were approved, plus three additional programs: \$125 million for B-52 Strategic Air Command bombers; \$21.2 million for turbofan engines for Military Air Transport C-119 aircraft and \$8 million for a language pit transport for the President.

No. E-70 Acceleration

The authorization represents the maximum amount that can now be appropriated with appropriations. The money is available to the B70 Mach 1 bomber program—already signed by Air Force—and Congress authorized only the \$200 million Ford 1962 development program of the Advanced Technology Bomber.

With this development, Air Force will move before the House appropriations subcommittee, approved analogies for B-52 bomber funds, and outlined a program of producing 52 additional aircraft for \$575 million. With output scheduled at four per month, the would keep production at the Boeing Wichita plant open until March, 1967.

Congress appears likely to vote the \$751 million in appropriations for fiscal 1972 under Secretary of Defense Robert S. McNamara voted to compress several nonmilitary items that he would leave the defense on additional \$320 to the President. At a press conference, he said he would recommend against it.

Other highlights on defense programs

Soviets Practice for Major Air Show

Moscow-Soviet air force is expected to stage its first major military air show in the south on July 9, probably at Tbilisi Airport, in observance of Soviet national aviation day.

Large numbers of Russians are being arrested have been pointing over the Turkish sea recently. Soviet Foreign, publication of the USSRAF Central Committee, has again with of the flying organization to take "an active part" in movement for the building.

Typical day's practice in the past two weeks has included this long sequence: • M-1 and M-4 helicopter fly over as formation. Transports arrive perhaps separately at both ends and stage. Arrivals are performed by single aircraft of these types: M-15 (Formet), Sa-15 (Fukidol) M-21 (Furphyite) M-6 of the two which NATO calls Etna, and M-17 (Formet).

- Specific locations of the following types totaling about 125 aircraft type: T-28 (Beech) bombers, Y-46 (Boeing) bombers, M40 17s, Y-29 (Flanlight) all-weather fighters, Se-35 (F3400), Se 161 and M4C 23s.

Speculation has as to why the military flights are being resumed after a five-year break includes the possibility that it is an attempt to compensate for the lack of Soviet military participation in the recent Pusa Air Show and the possibility that it is intended as a reminder of Soviet military strength. It is expected that Western observers will be invited to the Soviet show.

Offshore Nova Launch Facility Studied

By Irving Stone

Los Angeles—Proposals are due June 19 in a competition sponsored by NASA's Marshall Space Flight Center for a 10-year, 15,000-sq-ft launch stand for an offshore launch facility to accommodate the 12 million lb thrust first stage of the Nova vehicle.

The launch site is projected to be 10 to 15 mi out in the Atlantic Ocean off Cape Canaveral, because the region and associated hazards associated with the large Nova vehicle require a large separation distance between the launch facilities and civilian communities.

Proposals in a similar competition for the Saturn C-2 boost vehicle (ATV Min E, p. 58) have been selected recently in favor of the Nova facility, which apparently could accommodate the considerably smaller Saturn booster. Magnitude of the design and construction task for the Nova offshore launch facility is underscored by the vehicle's size. One version, presumably the maximum size Nova, is in its stage

configuration more than 366 ft high, tapering from a diameter of 65 ft at the booster base to 15 ft diameter for the top stage. This configuration still is not fixed as a design, but is projected to incorporate these proportions only.

• **First stage**, developing 12 million lb thrust, is composed of a cluster of eight Rockwell-Bell F-1 engines which will be fed by 6.4 million lb of RP-1/liquid oxygen propellant. Estimated dry weight of the stage is 531,000 lb. The first stage diameter will be 65 ft in diameter, have a height of 68.55 ft, to the top of the cluster.

• **Second stage** will be a pair of F-1 engines, will be fed by 1.8 million lb of RP-1/liquid oxygen and have a dry weight of 114,000 lb. Stage diameter is 26.67 ft, height 55.55 ft.

• **Third stage** will be composed of a cluster of four Rockwell-Bell J-1 engines, each developing 250,000 lb thrust, for a total of 1,000,000 lb thrust for the stage. Propellant load for the stage will be 700,000 lb of liquid hydrogen/liquid oxygen. Stage dry weight is estimated to be 91,000 lb. Diameter is

26.67 ft, and the height is 55.55 ft. • **Fourth stage** is a single J-2 engine fed by 190,000 lb of liquid hydrogen/liquid oxygen. Diameter is 35.55 ft, height is 30.35 ft.

• **Fifth stage** is projected to be a cluster of ten Pratt & Whitney LR-115 engines (Saturn S-IV stage) each developing 115,000 lb thrust, for a total of 1,150,000 lb. Preliminary load for this stage will be 100,000 lb of liquid hydrogen/liquid oxygen. Stage diameter is 15.15 ft, height is 35.16 ft.

• **Sixth stage** will be a pair of liquid hydrogen/booster units fed by 22,000 lb of propellant. Diameter is 15 ft and height to the tip of the space vehicle above the stage is 33.67 ft.

Nova is a modular concept calling for various staging combinations. NASA has requested \$44.5 million to begin development of a 4-stage Nova vehicle and conceptual studies are under way for a five-stage vehicle.

As described in Washington by Mr. Gen. Dan R. Osmand, NASA launch vehicles director, to the Senate Space Committee last month:

• **NASA 4-stage Nova** will consist of eight F-1 engines clustered for the first stage, two F-1s clustered for the second four J-2s clustered for the third, and an LR-115 for the fourth.

• **NASA 5-stage Nova** will have the same four stages with a cluster of ten LR-115 engines for the fifth stage.

Air Force Nova

Air Force also will develop a Nova to NASA specifications with a solid propellant booster and possibly a second solid stage. Third and fourth stages would be the same as the NASA 4-stage vehicle.

Estimated total combined propellant load for the 4-stage Nova is expected to be 9,012,000 lb. Estimated total propellant gas requirements for the vehicle will be 710,000 gal of liquid oxygen and 60,000 gal of liquid hydrogen.

The 1.5-million-pound thrust F-1 engine is projected for preliminary flight testing to be completed in 1961. All major components have entered the test phase during fiscal year 1960, and hardware for the first three engines is now being fabricated. Design Phase 1962, thrust chamber tests are projected to be conducted at full power for durations up to 10 sec. Full duration planned for the engine in 1970.

First test of a complete Rockwell-Bell J-2 engine system is projected for fiscal year 1962. Preliminary flight testing is scheduled for early 1963, and qualification is scheduled for mid-1964.

Research on the loose problems asso-

Bambi Fund Allocated

Los Angeles—After numerous reviews, funding allocation for feasibility studies to Air Force's Project Bambi-bolic missile boost stage—includes \$1.21 million each for Space Technology Laboratories and Hughes Aircraft and probably a slightly higher amount for Convair. Convair and STL will perform system studies with Hughes performing work on substructure areas such as internal arch and tank and closing engagement. There is a possibility that Hughes also may be given an assignment for the missile's atmospheric vehicle study along with development from its extensive Falcon missile development.

Contract with a liquid hydrogen/booster engine is being conducted at NASA's Lewis Research Center.

The concept for the offshore Nova launch facilities envisions a total requirement for three launch pads. These could be located on fixed, above-water structures, on man-made islands, Texas Towers or dyke-like islands to pontoon and anchored, or on below-water concrete. In each case, an umbilical tower will be acquired, together with a compatible fuel, steel fuel or movable service structure.

Propulsion is that the launch could involve booster vehicle assembly and checkout building and other necessary, technical supporting buildings will be

located on the Cape mainland. The booster assembly building is planned to accommodate a minimum of three assemblies here, with a possibility for expansion to six units. Upper stages will have to be overhauled and checked out on the launch pad.

Other Basic Features

Other basic features involved in the offshore launch concept for Nova will include:

• **Transportation of vehicle stages**, components, equipment, personnel and supplies from the Cape to the offshore launch pad. Transportation systems now involve containers, barges, boats, or helicopter modes.

• **Evacuation and environmental protection** for the vehicle on the launch pad. All structures and buildings will have to be designed to withstand winds up to 125 mph. Vehicle stages also will have to be protected during the critical loading phases.

• **Propellant storage, transport and replenishing** systems. Mounting of environmental protection facilities on water-lift roads will be considered, along with underwater or floating-tank storage of RP-1 fuel.

• **High-pressure gas storage and storage** systems.

• **Land-based versus offshore electrical powerplant facilities.**

• **Crews and tracking facilities** which may be required near the pad.

• **Support facilities** for 500 to 600 work-

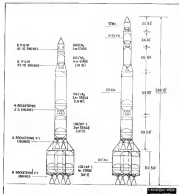
Titan-Mercury Studied

Officials of the NASA Space Task Group will visit the Martin Co.'s Denver, Colo., plant late this week to inspect use of Titan II and Titan II vehicle studies to launch for station around space flights between the present Minuteman program and the proposed Apollo program. The spacecraft would be a modified one-on-one Mercury capsule and would probably be heavier in structure, modernize new research instruments and flight control equipment. NASA officials also that Titan is being considered as a booster for any missions now included in the Mercury program. They say it would require 18 months to prepare the vehicle for Mercury missions.

work at the launch pad during work shifts. Standby crews will require quarters while others will concentrate in the mainland.

• **High cost of marine construction** will require prefabrication on land for components of the offshore structure.

In the concept developed for the Nova offshore test, consideration will be given to the possibility of incremental construction of major facilities such as research building, transportation equipment and launch pads. Because of the magnitude of the funding requirements for the program, successful funding for construction of the facilities will be an important consideration.



TWO CONCEPTS for NASA's Nova space booster show machine concept variations. Six-stage vehicle is apparently the largest contemplated. NASA also has studies under way for the five-stage vehicle.



B-52H Makes Test Of Skybolt Compatibility

Competition flight test studies the Boeing B-52H with Douglas Skybolt missile test flights is made from Boeing's Wichita, Kan., plant. Earlier work was made with test Skybolts along with a B-52C modified to carry a B-52H (AFW Jan. 18, p. 10). The new H-model bomber will carry four long range, hypersonic nuclear-armed Skybolt missiles in addition to nuclear weapons on its bomb bay. Deliveries estimated include a 20-mo. -duration flight 1960 missile a month.

Explorer VIII Data Analysis to Show Electrical Drag Effect on Satellites

Washington—Significance of electrical drag on satellite behavior will be determined from Explorer VIII data now being analyzed, according to the National Aeronautics and Space Administration.

The Explorer VIII satellite, which made the first direct measurements of the ionosphere, was launched by a Juno II New 1. It returned 160 bits of data during each second of its 14-day mission. NASA estimates it will take another six months to complete analysis from the ionospheric and macrocosmic environments. Ionospheric physics experiments previously had been done by radio propagation and with sounding rockets.

Robert Rodgers of NASA's Goddard Space Flight Center, ionospheric experiments project manager, announced these preliminary findings based on analysis of about 15% of the data.

• Ionized clouds which surround satellites double the electrical size of the satellite. Size of the solar atmosphere depends on cloud particle density.

• Radio blackout apparently is caused by ionopopulation in the lower ionosphere, below 160 mi., since the upper ionosphere is relatively undisturbed during solar storms.

• Oxygen is the main constituent of

plasma of being ionized in the lower part of the orbital path. The satellite has a 275-micron perigee and 1,690-micron apogee. Hydrogen predominates above 550 mi.

• Electric temperatures closely coincide with the value of the ionospheric potential of ionospheric gas, which is 1,800K.

Satellite analysis of the recent cloud data indicated that the leading particle consists of positive ions, with negative electrons in the wake.

Wesley M. Alexander, also of Goddard and project chief for macrocosmic and ionospheric, and Explorer VIII supports by maintaining the presence of small particles in the lower ionosphere.

Large particles in the stream have been detected by telescopes and radar, and the Explorer VIII satellites revealed thousands of impingements of particles trailing in size from one-billionth to one hundred-billionth of a gram. Data is being correlated with findings from Voyager III, which had an impact equivalent with a minimum impact sensitivity of one-billionth of a gram.

NASA hopes to relate macrocosmic analysis and data from the latter test. NASA and the Explorer VIII experiment advanced the art of spacecraft technology by lightening a satellite

optical saturation device accurate to within 5 deg. The satellite contained several air and chlorine traps which absorbed charged particles and acted as an angle-of-attack meter. The signal produced was compared with the directional channels of electronic currents off the surface of the satellite, and an error signal was provided.

Refinement of the device could reduce the accuracy error to 1 deg., NASA said.

Future ionospheric tests will be made by combining several of the experiments into a single instrument to be used as a tool during future Explorer missions large to fly the instrument package on each period as passive communication satellites.

Canada to Build F-104s With Funds From U.S.

Washington—U.S. will furnish 60 McDonnell F-104B all-weather interceptors to Canada under an agreement in which Canada will produce Lockheed F-104 fighters for European nations and will receive financing of 16 early warning radar stations.

Under an agreement following months of negotiations (AW Apr. 29, p. 27), the cost of financing, operating and maintaining the F-104Bs is to be borne by Canada, except for some actually furnished parts.

For the F-104 production program, the U.S. will contribute \$170 million and Canada \$50 million. These sums are subject to military budget requests and legislative approval as both countries' legislatures are scheduled to begin in mid-1965.

These funds would provide for construction of about 116 aircraft. They specifically will go to General and Tully under the U.S. Mutual Defense Assistance Program.

The F-104 is similar to the F-304G being built by NATO countries.

The F-104B is limited to the same atmospheric mission.

Sen. Stuart Symington (D-Mo.) criticized the agreement to produce the F-104B in Canada as pending uncompleted U.S. aircraft production.

Five of the 16 order stations will be U.S.-owned but otherwise Canadian supported. They are at Mississauga and Saint-John, Quebec; Bonaventure and Sackville, Nova Scotia; and Gander, Newfoundland.

The stations which the Canadians will finance and operate are located at Rilly Hedges, Bonaventure, Pointe-aux-Loup, and Saint-John, Quebec; Calabogie, Kenora, Minnesota, Armstrong, Lethbridge, Regina, Winnipeg and St. John, London, Ontario, and Brampton, Nova Scotia.



Bell's High Performance Navigation System—spaceborne.

HIPERNAS!

It can pinpoint a long-range missile on target. Guide a satellite or space ship to any point in the universe. Regulate the predetermined course of a surface vessel or submarine to any spot on the ocean floor — by any route, however circuitous.

In manned vehicles, it will give exact position — even without an atmosphere — independent of gravity, sea, wind, and weather conditions — without loss on horizon or over — after days and weeks of travel.

This is **HIPERNAS**, a self-compensating, pure optical guidance system developed by Bell's Avionics Division. Designed for the U.S. Air Force, **HIPERNAS** is no versa-

tile that a whole family of related systems has been engineered for application in any environment — sea, sky, or space.

The system incorporates new Bell BRIG gyro, 30 accelerometers and digital velocity meters are already operational in missile and space guidance systems.

HIPERNAS — and many other systems such as the Air Force GSN-3 and the Navy's SPN-10 All-Weather Airborne Landing System — typify Bell's capabilities in the broad field of electronics. This diversity of activities offers an interesting personal future to qualified engineers and scientists.



BELL AEROSYSTEMS COMPANY

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Germany to Order Super Frelons, S-58s

West-German Defense Ministry plans orders for 319 Bell S-58 Super Puma helicopters to meet its heavy transport requirement after 50 Sikorsky S-58s raised at about \$27.5 million to fill the gap until the TH60s begin arriving in the mid 1960s.

The decision, closing out a competition that has been debated and redrafted in technical and political circles for almost a year, followed a series of high-level talks between government officials of the countries involved.

The Super Puma, as it later passed by West-German plans for a quantity order (AW May 28, p. 24), is scheduled to be produced in Europe in a multi-variant form. The S-58s, whose orders will appear soon on a government procurement list, will be produced entirely in the U.S. Sikorsky also will work closely with Bell in a bilateral assistance and cooperation development level in the final design of the S-58B, which is still in the making stage.

Although plans are still tentative the present program calls for component production in Germany, and in Italy by Fiat, which already is building Sikorsky S-58s into contract under license and has a helicopter of its own in flight test, as well as by the Fiat. Most probable German firms to join the consortium is Boeing's West-Phlogem. An affiliate of United Aircraft Corp., West is now building the Bell Sikorsky S-64 which serves in the West-German Defense Ministry.

Multi-nation production plans, which followed the German decision to order the Super Puma over competing U.S. designs that could have been available substantially earlier, follows to the spirit of a jointed agreement signed by the three nations in 1955 for mutual cooperation in the development and production of a helicopter family.

The Super Puma was a late entry in German consideration for a heavy transport helicopter to meet its military needs (AW Jan. 8, p. 37). Other candidates, which had not met after high-level Franco-German negotiations, were the U.S. Sikorsky S-61 and Boeing Vertol 107.

OVER...
UNDER



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Holifield Urges U.S. Resume Nuclear Tests

Washington—Charmus Clark Holifield (D-Calif.) at the Joint Atomic Energy Commission said last week that the U.S. should resume nuclear testing even if the move were considered by the majority of the United Nations.

He said the U.S. "must assume the possibility in probability that the Soviets have been testing or will be shortly. In any event, we cannot continue to gamble our destiny when we have such a possible an ignorance of our opponent's actions."

Rep. Holifield stressed, however, that the U.S. should encourage negotiations with the Russians for a test ban, even while conducting nuclear tests. He suggested strong aid by testing weapons destruction device development, declaring they are "so necessary and important part of any test ban system."

The severe requirements should be followed by tests of nuclear weapons and peaceful application of nuclear energy under the Russian program.

Rep. Holifield said, "No tests should be made in the atmosphere. He added, but he did not oppose nuclear tests in space. Rep. Holifield, who stressed he was speaking as a member rather than chairman of the Joint Atomic Energy Commission, said these new "certainly" would be tests of nuclear weapons that should be tested in the atmosphere. He said nuclear tests would involve concepts on the drawing boards "which could be as revolutionary as the H-bomb in 1949."

They would also help develop lighter weight-to-weight ratios for missiles, new kinds, new missile missiles, better small weapons and improved safety for tests.

Boeing Seeks 107 License in Europe

Paris—Boeing is negotiating license agreements with Dassault-Bretonnet and with other firms in France and Italy for production rights to the Vertol 107 of helicopter license orders for the turbine engine helicopters are obtained.

Despite the West German decision to purchase France's SNI 1219 Super Puma to meet its major heavy military helicopter needs (see page 16), Vertol still has hopes of selling the 107 there and is pushing into Europe in England, Belgium, Italy, France and other NATO countries.

An on-site trip toward establishing a firm European base of operations, the company announced last week that it is forming a Swiss subsidiary to be designated Boeing-Vertol Europe S. A.

As an initial step toward establishing a firm European base of operations, the company announced last week that it is forming a Swiss subsidiary to be designated Boeing-Vertol Europe S. A.

Immediate objective of the new firm will be to build 107 sales and service centers in Europe. If Europe gets decision in forthcoming months, negotiating rights will be granted to the Swiss subsidiary, which, in turn, will pass them to Danish and other licensees.

McNamara Orders Two Joint Fighter Projects

Washington—Defense Secretary Robert S. McNamara has modified his plan to develop a single two-seater fighter, officially postponing the plan at least two different aircraft and possibly three described by Avionics World early last month (May 6, p. 20).

McNamara has given the Air Force responsibility for developing a tactical fighter, USAF's role with the Navy in developing specifications to ensure that the design will meet the needs of both services for interception, reconnaissance and support and close support.

He also has assigned the Navy the task of developing a smaller aircraft for close support to meet the needs of the Army and the Marine Corps. Each service would have the opportunity to approve the original concept. This design could be a successor version of the Douglas A-10, or a new aircraft.

There would also be a common order for a close support aircraft, but the Army is expected to have wilderness or original maneuverability for the A-10. Among the Air Force and the Navy to get together on the higher performance aircraft, the common order over cost and configuration.

To have a low-level speed capability of Mach 1.2 and a high-altitude speed over Mach 2 combined with a turn radius of 1000 to 1,500 ft, the aircraft would have to weigh about 15,000 lb. This weight would be over the limit that the newer aircraft carrier can handle and the design would be too large for deck handling.

Stennis to Investigate Nation's Survivability

Washington—Senate Preparedness Subcommittee Chairman J. William Stennis will take a new look next month at U.S. survival power, with special emphasis on the nation's ability to survive an initial attack.

Chairman John C. Stennis (D-Miss.) told Avionics World he believes this probe into survivability will be the first ever made in a detailed fashion by a congressional committee. "Our survivability program will be taken up with emphasis," Sen. Stennis

said. The subcommittee will call on top military officials, specialists and defense industry officials to get a wide spectrum of opinion on survivability. Hearings will be in closed session.

Sen. Stennis said that another emphasis in the upcoming investigation will be on the current status of the missile force. "They talk a lot about capability," he said. "I want to know what we have now."

News Digest

Rep. Gen. Paul T. Feyer was named military adviser to Federal Aviation Administrator N. E. Hardy last week. Formerly FAA's assistant administrator for flight, he will take charge of the Department's Bureau and also serve as special adviser to FAA's aircraft transport program. Deputy Administrator Bruce T. Feyer will gain the additional duty of acting administrator for plans.

North American Aviation will start construction in September on a \$3,000,000, 100,000 sq ft transportation assembly building in Princeton, N. J. The new unit will be a final plant for the company's jet divisions.

Center General Wing Corp. has withdrawn its request for a hearing to determine whether Stennis and Edwards, Commission should receive a Dec. 28, 1960 order temporarily suspending a Republic A-105 acquisition from Stennis Air Corporation with respect to a proposed stock offering. The suspension order disallows the company's SEC statement in connection with that the company's offering would be too large and misleading regarding certain financial facts.

Navy has developed a system for aerial removal of persons at sea or in remote land areas. A packet dropped to the person contains a survival vest and a 100-lb oxygen tank. A balloon is inflated with helium which lifts the line into the air. The aircraft seizes the elastic nylon line and the person gradually is elevated to the deck of the engine and is then hoisted into the hangar.

Alan L. Doss was appointed deputy administrator of the Federal Aviation Agency last week (AW June 5, p. 43). Ely, one of the three deputy parts created by Administrator N. E. Hardy, Doss, who joined FAA in August, 1960, was formerly assistant administrator for management services.

Alexander G. Hardy, senior vice president and corporate secretary of National Aeronautics, resigned his job with the company to join the board of directors of Avionics in contrast to the board of directors.

Foreign Lines Try to Prove U.S. Reneges

European carriers research old statements, records to show American reversal of bilateral principles.

By L. I. Doty

Four-European flag carriers, alarmed over growing demands for traffic restrictions in certain North Atlantic markets, are launching individual campaigns designed to prove that U.S. interpretations of bilateral agreements are contrary to the original intent of Bermuda principles.

Several European-based carriers already have made extensive research studies into documents, memoranda, congressional testimony and interpretative statements or speeches by the negotiators of the Bermuda pact to back their contention that the U.S. has completely reversed its concept of the Bermuda agreement. The obvious strategy is to show that the U.S. is not living up to its obligations under the terms of international agreements.

The reported result is to raise the matter to top diplomatic levels, where they presumably will override any economic considerations at stake. To counteract these tactics, U.S. carriers are now changing that a number of foreign carriers are violating the original terms of their bilateral air transport agreements by offering excessive capacity and flight frequencies as primary war aims and by charging too much U.S. traffic in secondary or Fifth Freedom markets.

Pan American vs. KLM

Washington-Pan American World Airways has charged KLM with violating its privilege of access to the U.S. and U.S. Netherlands bilateral agreement on scheduled flight operations to and from the U.S.

In a complaint to the Civil Aeronautics Board, Pan American said the violation stems from KLM's offering air service to great extent of the number of passenger seats and volume of cargo reporting requirements between Netherlands and New York and the U.S. which is the exact opposite of the service.

Pan American also said KLM exceeds the volumes to carry amount of traffic between the U.S. and third countries (Fifth Freedom traffic) for as much as the "secondary" or "top up" volume provided by the intergovernmental agreement. The action said that KLM offers more service than can be justified "on the basis of traffic which the carrier is able to handle and equal opportunity to others."

KLM denied that it has violated or intended to violate any portion of the agreement. A Dutch delegation is here now negotiating with the State Department for a route to Los Angeles. Capacity estimates are a key to the talks.

traffic in secondary or Fifth Freedom markets.

The fight, which has been waged continually for almost a decade, now promises to become especially bitter in competition situations with jet air carriers steadily outstripping traffic growth on North Atlantic routes. Effect of the dispute is the degree to which this capacity should be controlled in order to provide a "fair and equal opportunity" but the amount of bus routes to operate any route between their respective territories covered by the agreement.

Original Policy

Originally, the U.S. strongly advocated a non-discriminatory policy during the Chicago Convention of 1944, which the impact of foreign nations sought some control of flight frequencies. The U.S. was one of the opposition on equal service terms, and it is this original policy of the U.S. that foreign carriers are now using as evidence that the U.S. has violated its interpretation of the Bermuda principles.

For example, British freighter vigorously for some control during negotiations at Bermuda and finally concurred to the Bermuda principles only because they represented a compromise between a discriminatory and non-discriminatory policy. However, in a letter from the British government to the U.S. secretary of state, protesting a Civil Aeronautics Board investigation to determine whether foreign air carriers were should be served to provide flight frequency control, that protesting was disclosed.

"If foreign air carrier permits were awarded in this manner, the Civil Aeronautics Board could unilaterally deter-

mine an advance such questions as the capacity, frequency and type of service which would be provided by United Kingdom airlines as flights to and through United States territory. The conditions under which United Kingdom airlines were permitted to and through the United States are those set out in the Bermuda Agreement which, as both parties have mutually agreed, does not give either party the right to determine unilaterally such questions as these."

Because the Bermuda Agreement is a reciprocal agreement, advantages are available and permit a wide range of transportation. U.S. carriers hold that the equity clause of the agreement specifically requires restriction of the services or available seat miles when one party feels that an undue amount of seats is being offered on any one of the routes involved.

Foreign Arguments

Foreign carriers, however, believe that the U.S. is now pursuing a new interpretation of the Bermuda principles which is contradictory to the philosophy developed by the original negotiators of these principles. Here is a word effort of a European carrier told Aviation Week.

Bilateral Policy Warning

Washington-Civil Aeronautics Board Chairman Alvin S. Ford told Congress last week that the U.S. must "refrain" its policy on international air service and capacity, or face more difficult talks with foreign governments as the future.

Ford emphasized to a Senate appropriations subcommittee the need for more pressure to handle international services, such as increasing in volume and complexity. In the past, he said, CAB has generally been able to deal with requests bilateral basis, but now at least that "lines of countries are engaging in extensive pressure and acting as a unit" to limit the traffic served by U.S. carriers.

Noting that the airline industry last year had a net profit of only \$5.5 million on revenues of \$2.6 billion, the chairman said there is doubt whether the industry could survive if it were forced to share the U.S. traffic market.

"To us, indeed, the proper interpretation of the Bermuda Agreement is one arrived by the airlines and negotiators in a well documented and acknowledged process before a Senate confirmation committee in 1946 by L. Wald's flight, then CAB chairman and a delegate at Bermuda. That carrier estimates that estimated by Page."

The first point I want to mention about the bilateral principle is that it is true that this (Bermuda) agreement provides no control over frequency and that was basically our position. Changes by the U.S. that would European carriers are violating Fifth Freedom rights by carrying an excess volume of secondary traffic are fully covered by the design of that carrier. Attempts by the U.S. to obtain an ex-

cess or to reduce the intergovernmental allocation of capacity."

Another carrier notes in testimony given before a Senate confirmation committee in 1946 by L. Wald's flight, then CAB chairman and a delegate at Bermuda. That carrier estimates that estimated by Page.

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CAB Seeks Northeast Merger Partner

By Glenn Garrison

New York-Civil Aeronautics Board moved last week to help Northeast Airlines find a merger partner in a new out of the airline's financial condition, which included a loss of \$1.5 million for the first four months of 1961.

Ordering an investigation of Northeast's situation and prospects before deciding on renewal of the carrier's route to the north, CAB included the question of whether Northeast should be merged with another airline if that is now in general. At the time CAB began its investigation last month, it was in the process of transferring ownership of traffic northeast, including operations and profits and losses in 1961 if they were to merge with Northeast.

In effect, the investigation is designed to determine whether a third carrier is needed on the northeast-to-Florida route and, if so, if it is in the public interest to merge Northeast with another carrier.

Northeast's temporary authority to serve its main route of New York to Cape May, N.J., was set to expire November 1. Facing a merger partner, therefore, is "imperial" was Northeast's position last week, a better deal while the Florida route is still available, with the party pending the final answer on whether the merger would be more permanent. North east recently has indicated approval of at least one carrier, Delta Air Lines.

Observers say another possibility of Howard Hughes seeking a merger partner in Northeast. He has been in the airline business since 1946. Northeast's management to lose Conquest 100 aircraft.

Northeast recently refused to extend the deadline by which TWA-Wald Airlines was to decide on a merger pro-

posed by Northeast. James Austin, Northeast president, said that refusal was based on the fact that the TWA board never acted and through TWA-Wald made the immediate prospects of divorce uncertain. Northeast was faced with a decision to either sell or bring new offers and still to be free to act. But Northeast is still available to sell without TWA.

The intense competition is available to be used by Eastern Air Lines, which opposes Northeast's recent application. Eastern has no desire to choose any proposition that is subject to a decision by a third carrier of Northeast's Florida.

Meanwhile, Northeast has been competing strongly in the Florida markets with its air fleet of 100. Work was set scheduled from the northeast to Florida via other air routes, including Northeast's winter season traffic in and out of Florida was up 27.5% for the December through April period for a total of 105,000 passengers.

According to Austin, Northeast's share of the Florida market was about 21% by the end of the first quarter of 1961, up from 17% at the end of 1960. Long-term growth for the Northeast business is expected, then, says Austin told Aviation Week. "Explosive" operating conditions have a winter standpoint, and therefore problems in interpreting the best of its quality. Northeast is expected to be about six weeks of the peak Florida season with a full fleet of jets. The last season went into service Dec. 15, and the entire fleet of six was not due until Jan. 15, according to Austin. It had been hoped that all aircraft would be available for the winter season, but emergency to force the airlines to extend financial and delivery caused a delay (AVW Nov. 25, p. 31).

change of traffic situation with these airlines to the actual volume of Fifth Freedom traffic can result in determining the value of Fifth Freedom.

Observers feel that foreign flag carriers will monitor the changes at Fifth Freedom volume by attempting to show five U.S. carriers are doing a substantial amount of Fifth Freedom traffic in other parts of the world, particularly in South America. They will also emphasize that their carrier has been a financial development that defines what constitutes "excessive Fifth Freedom traffic."

Generally, restrictive measures have been taken against the U.S. by at least four South American countries and several Latin American states also take restrictive measures.

The final subsequent arrangement was the formation of a special corporate trust. Nolon, Inc., to purchase from General Dynamics Corp. the seven year lease for the air B50, under which the manufacturer is operating the aircraft. Nolon is owned jointly by Avian Financial Services, Inc., an affiliate of the New York investment firm of Smith Barney & Co., and Republic Corp. of New York, largely owned by the Electric Automobile Co. Avian recently acquired Miller Aircraft Co. in case of default, however, General Dynamics would be called on for payment.

Whether Austin and men concerned the board that might naturally have arrived to Northeast due to strikes at Eastern and National. With the extra mile available for the saving, Northeast may not have to reach a goal but of the time.

Austin said his airline was able to begin jet service last December only because he is "a specialist at last," because a number of things had to be done in advance, before the jet financing had been financed up. For example, available funds had to be allocated into various areas with some with less than of the six to eight months if jet introduction was not to be further delayed. After the first jet were acquired and service began, one problem which kept up operations was the need for proper positioning at gate ports at various stations. Experience was required to handle this activity.

The airline's daily operation with its B50s and a single jet, in Austin, said, was a struggle. It might be better but for the fact that many B50s fly by a short segment before a long one—like example, Boston to New York and then to Miami.

In March after the next 150 seat



WEST WING (left) of the Orly terminal building has been completed and provides parking space for 24 aircraft. Buildings to the right of the terminal will be used and an east wing will be constructed to increase aircraft parking space to a total of 48.



EXPANSIONS provide fast accessibility from Paris to new Orly Airport. View shows main entrance to the new terminal building with National Highway No. 7 going directly under the terminal and the new wing of the airport.

Orly Airport Automates Procedures for

By L. L. Doty

Paris-Orly Airport Authority's 521-million terminal at Orly Airport, now in its fourth month of operation, stands out as a test case in how self-sufficient passengers can be in following check-in, immigration and customs procedures.

The terminal was designed to eliminate the "bumping routine" as boarding passengers and, thereby, abandon the established European practice of grouping passengers under the guidance of an agent at baggage for each step they must take toward boarding an airplane in international travel.

Already the "Orly system," as the new streamlined passenger handling procedure has been labeled here, promises to be one of the first fully practical methods of combining the flow of both inbound and outbound passengers efficiently and easily. There has been criticism leveled at the system from both passengers and airline personnel but, generally, dissatisfaction stems from minor details of the operation and not from the basic overall system.

Under the Orly system, a passenger offers his baggage for customs inspection at the airline ticket counter at the same time he checks in for a flight. He then follows direction signs to the customs border control where there

are 17 immigration clearance points, and then proceeds on his own to the departure gate to board his aircraft.

International flights can be boarded only at one hour before departure. If the passenger has any doubt as to the proper boarding location, he can pick up a telephone installed at each gate and remain aware by queuing the flight control information system. If he chooses to wait in the terminal for flight departure, he can stop at the lounge containing shops, a nursery, bath and changing rooms, a chapel for all denominations, bars, a restaurant serving 300 persons, and 36 modern hotel rooms.

Facilities Analyzed

Paris Airport Authority spent three years studying and analyzing airport facilities throughout the world in anticipation of Orly. Airlines were consulted frequently, although not as often as many would have liked, in the planning and development of the Orly system. As a result, most of the airport's features are tailored with the technical features and functional makeup of the new terminal to contrast the terminal has not received the volume of criticism that has been directed at New York's International Airport or Rome's Leonardo da Vinci terminal, two of the most modern international facilities.

Major problems have been the pas-

senger himself, who at every moment but in empty space, not appreciating a coordinated independence. Airlines here are learning that more instruction is needed than usual, the verbal instructions of uniformed personnel and their signs, without the comfort of this guidance, often get lost despite the simplicity of the Orly layout.

Airport officials here, however, stress that passengers will gradually become familiar with international airport routine as they are with airport depart routine in the popularity of an arrival airport. They also point out that as individual airlines will become more thoroughly indoctrinated and efficient in traffic volume given.

Passenger traffic through Paris is expected to reach 12 million in 1961, 12 million by 1975.

Many passengers have complained of the long distances they are required to walk between airplane and airport entrance or exit. However, it is an easily capable fact that heavy traffic demands large foot areas which leave no alternative but to walk. Orly's walking distances have been used by a large number of airlines and direct or straight passenger routes from one point to another. Baggage counters are located only a few paces from entry and exit points.

Much of the convenience of the Orly terminal rests on its electronic system

Passengers

which operates facilities such as the customs, information boards, public address system and clocks. When the system fails, as it repeatedly often has, the passenger is bogged down in a web of confusion.

Station Managers

Airline station managers are slightly concerned with the time consumed by the lengthy walking distances. One system manager told Aviation Week that if a passenger had not checked-in at least 11 a.m. before plane departure time, he could not possibly make the flight.

All downtown checking-in has been eliminated at Paris. The traditional terminal check-in area is terminal in writing as an information and travel bureau as well as a bus station for transportation to Orly and Le Bourget. Paris' second major airport.

Orly's new terminal can be expanded to accommodate 15 million passengers per year. Then, Paris airport officials will continue to operate. Le Bourget, which has a capacity of 4 million passengers annually, to handle the surplus from Orly Airport.

Orly will be the main international airport for Paris and will continue to handle a large part of inter-European traffic. Le Bourget is the terminal for European carriers, including Aeroflot and is a focal point for a large network

of routes that reach into Africa.

Orly has become a major transit structure in Paris and is now playing host to as many as 25,000-30,000 airplanes a year. Originally, the leaders of Parisian thought the flow of an international airport is the conclusion of a new passenger handling system. However, simplified terminals for business have been established and passenger facilities have been added off from the airplane's nose to there is a disconnection between the two groups.

Paris Airport Authority, which is responsible to the French Ministry of Public Works and Transportation and is supervised in the Ministry of Transport, is governed by a board of directors consisting of 24 members. The Authority operates both Orly and Le Bourget.

The Authority is not responsible for air traffic control, which is managed by a separate government agency, but it provides and maintains the facilities and installations necessary for the service. The Authority also builds and maintains runways, approaches, aprons, hangars and maintenance facilities. Maintenance of landing aids, obstacle lighting systems, windmills, parking lots, and customs and the terminal itself—which employs 10,000 persons—is the responsibility of the Paris Airport Authority.

In planning the terminal building, the authority rejected the separate building system, such as that now in use at Atlanta, as "unconventional and inconsistent."

All facilities—including airline and government technical and administrative offices, air traffic control and weather bureau offices, employee lock rooms and locker rooms—have been concentrated in the new terminal. However, all such facilities have been subordinated to the area designed for passenger service and safety.

Control tower, which is now located on the eastern edge of the field, will eventually be rebuilt on top of the terminal which contains nine stories and covers 1 million sq ft of floor space. It is the largest building that has been constructed in France since Louis XIV arrived the Invalides. Formal construction begins in 1962.

Ticket Counters

Individual airline ticket counters—45 counters including four French airlines serve Paris—are located in the main hall, which is 520 ft in length, off the main entrance to the terminal on the first floor.

The control lounge, 560 ft in length, is located on the first floor. Shops, bars and a post office are located in this main waiting room equipped with an adequate number of seats and tables. The customs-free lounge occupies the second floor.

The third floor contains a bar, snack bar, coffee shop, special lounge restaurant for 150 diners, the formal "Le Tournebroche" restaurant and a dining room with a direct floor for special parties. Two conference rooms and a theater accommodate 350



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people, which has not yet been located by a reconnaissance, are also available. In addition to the 15 rooms in the main terminal area, 48 hotel rooms are under construction on the fourth floor on the French side of the customs frontier.

Several other airlines have leased space within the terminal to provide service for their "very important passengers." Although most of these special rooms as yet has been completely equipped and decorated, it is difficult to see how the relatively small spaces allowed the airlines for this purpose can match public facilities for use, need.

Paris Airport Authority has set aside three special rooms for handling government dignitaries. In addition, a special airport lounge, furnished with airways French furniture and appliances, has been reserved for high-ranking officials. A private terrace off this area permits military reviews without disturbing the normal functions of the airport.

Baggage Movement

All baggage is moved to and from loading bridges on conveyor belts. The terminal is equipped with 14 passenger elevators, 21 escalators, six freight elevators and a medical elevator.

At the present time, there are 26 aircraft parking spots. Parking areas for aircraft are designated by a central control system which also operates the business signs that direct passengers to their flights. It operates the arrival and departure boards and handles all announcements on the public address system which are confined to three announcements for each flight.

A control and command section of the airport is integrated into the main floor of the terminal through the use of an electronic panel that approximates the size of the new floor of the building in real scale. White markers indicate spotting order of all lightening green, station second indication of lighting, redhibition and electronic markers, 1940 indicators glow and if one of the building's 4,000 fan-indicators shows a rise in temperature.

Ventilation System

The building's ventilation system produces 15 million cu ft of air per hour through 11 sq. ft. of ducting. A slight degree of pressurization within the building is used to keep outside air from entering the terminal through doorways.

In terms of passenger traffic, Paris now stands eighth in the world. Traffic handled by French carriers represents about 25% of all Paris airport traffic. North American carriers account for 10% of the total. Considerable portions of Paris traffic is that second tomorrow France and other European countries.



MAIN TERMINAL building at Orly Airport is about 400 ft. long and 230 ft. deep. West wing is completely out wing will be finished next year. Wings are each 530 ft. in length. Mainstay building contains about one million sq. ft. of floor space.

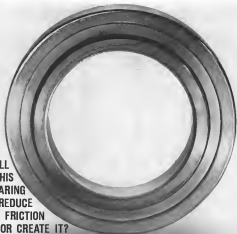


ALL FLIGHT information about arrivals at the glass-loading area of west wing is given on overhead panel. Telephones nearby connect passengers with flight information center.



TRANSIT AREA at Orly Airport. This area also has a tourist shop, a restaurant, 160 men's hotel, money and chapel.

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**French Transports
Perform at Paris**

Micé Hélicoptère Super Puma (above) flies over Le Bourget Airport at the 24th Paris International Air Show. Sud Aviation General Electric Gannett transport (center photo) lands with Chevrolet thrust reversers extended behind its CB55 turbo engine. Regent 940 STOL transport (bottom photo) designed as a derivative for the Regent 946 experimental military transport and the proposed 942 passenger-cargo version. Its second test 100 flight hours were last flight in 1990.





TWIN-TURBINE HELICOPTER. The Boeing YF-16—fast, standard riding instrument and helicopter now flying—gives new sense with New York Airways this summer. It can 30 passengers in comfort, cruise at 155 mph and operates with equal ease from

land or water. The YF-16, first twin-turbine helicopter certified by the FAA for commercial service, has also been selected for service in Japan. Military versions have been ordered by U.S. Navy, Swedish Navy and Air Force, and Royal Canadian Air Force.

Capability has many faces at Boeing



JET-AGE FIVE FIGHTER. Boeing jet two-engine power for trade in San Francisco and Seattle. These 747-200s will require only 300 pounds, priced \$1.5 million from existing fleet for 25 mph in 9 minutes.



SPACE FLIGHT. Boeing space shuttle research indicates growth in space shuttle for commercial use. Shuttle also capable as space vehicles. In fact, a Boeing commercial has lived all hours on space program origin in solid space shuttle, giving potential of serious dual-use program.

BOEING

Standard TBO System Proposed For Used Transport Transfers

Washington—Federal Aviation Agency has advised U.S. airlines interested in buying used equipment a standard system for rapidly attaching their enhanced overhaul times to industry averages.

The new proposal is designed to ease the economic burden that results when a carrier modernizing its fleet with used aircraft is forced by the present system to cut back on its inspection and overhaul (TBO) by actual lead-in to actual overhaul hours. Carrier comment is due at latest than July 15.

An outgrowth of the recent conference in Indianapolis between FAA and small airline associations (NAT) Apr. 17, p. 5), the system considers the relative complexity of different transport types and expands the relationship of a percentage on a scale.

Although the percentage in the FAA's proposed application and subject to modification on the basis of industry comment, 100% might represent the Boeing 747's "complexity scale" from a maintenance standpoint. The DC-10, then, would be rated at 90% of 700 maintenance complexity, the DC-8 at 55%, the C-46 at 30%, the DC-3 at 15% and the DC-1 and C-47 at 5%.

The FAA indicates these percentages are percentages unless they can be applied to standard TBOs assigned to commonly traded aircraft brands. As a result, FAA's Bureau of Flight Standards is developing "industry average percentages" or "TBOs for C-46 and DC-8 series aircraft. Comparable specifications governing C-46, DC-8 and Lockheed Constellation TBOs will follow when the agency has related the aid of airline maintenance officials in its program.

Partial Application

To illustrate the system's practical application, a C-46 operator interested in acquiring C-46s at 15% in replacement aircraft would have to advance what TBOs it could expect 15% to achieve. The C-46 operator could determine the 15% substituting the C-46's complexity away from the comparable 50% figure to obtain a percentage difference—15% according to present planning.

The purchasing airline would have to subtract C-46's overhaul time by subtracting 15% from the C-46's 140 and enter average TBO.

In its proposal, FAA explores the question of how long it will take a new operator to acquire the additional knowledge necessary to do an adequate job of maintenance using maintenance

and overhaul times that equal the industry average. The agency believes the answer is based on how much aircraft owner knows how the new operator already has when it buys the new complex aircraft.

The operator which has half the knowledge necessary to maintain a particular transport at the industry standard potentially will improve the other half by using the new operator's experience with an maintenance background, FAA's philosophy indicates.

To furnish the highly subjective judgments on which this approach is based, a Maintenance Review Board (MRB) somewhat similar to the board that sets the initial TBOs for new airlines and engines would be established. The "board" would be assigned to the operator making a purchase, one maintenance specialist from the FAA's appropriate regional office and one government chairman from the agency's Washington headquarters.

Setting New TBO

Under the proposal, when an airline orders FAA a planned purchase, the MRB will meet with the airline's maintenance officials. Together, the two groups will determine the relative complexity of the airline's old and new equipment. The value of the operator's old aircraft will be determined. As a result, the MRB will assign the new TBOs based on the basis of its relative value.

It is expected that this (airline average) will show that the TBOs for 747 and DC-8 are "average" according to George H. Wirth, acting chief of the Bureau of Flight Standards' maintenance division.

Next step in the process is an MRB determination of how much time must elapse before the new operator's TBOs, on engines and all time-controlled components, can be adjusted upward to industry average. In making this determination, FAA wants the MRB to consider:

- "Maintenance density" in the airline's shops. That the operator's staff, its facilities and its maintenance system can be expected to acquire technical expertise to handle that operator's own and new transport and an "all at once" overhaul program.

- "Formal training program" established by the new operator. FAA also looks that formal basic training program for mechanics and mechanics could shorten the time required to run an adequate TBO by as much as 50% before in-

dustry in major TBOs would be needed. However, the MRB would estimate and evaluate the operator's reliability record since it bought the new equipment.

This estimation would be based largely on the MRB's review of the industry average failure and further into the new compliance and duty mechanical reports on the occurrence of the aircraft.

KLM Electra Crashes On Landing at Cairo

Amsterdam—KLM Royal Dutch Airlines last evening reported two accidents that struck the carrier in succession over a two-week period. The accidents caused fatalities, during a total of 32 lives. KLM previously had gone down there twice without a passenger injury.

In the latest accident a KLM Lockheed Electra transport transport struck a sand dune on June 11 during its last hours before final approach to Cairo Airport after a flight from Amsterdam en route to Malaysia. Twenty of the 36 persons aboard were killed.

An airline spokesman said the aircraft, in landing gear down, had been cleared for final approach and was in the midst of a right turn when one of the wheels plowed into a sand dune. Out of control, it then smashed into another dune about 200 yards away, with the fuselage breaking in half. The tail end was caught fire.

The Electra arrived had been delayed to the Dutch carrier only this year. All aircraft maintenance accidents by the Federal Aviation Agency after two Electra broke up in mid-air over the U.S. in late 1979 and early 1980 had been recognized on the production line.

On May 10 a KLM Douglas DC-8 jet transport on line to Viana, Venezuela international airport, crashed into the ocean 14 mi. off the Portuguese coast shortly after taking on a scheduled flight from Lisbon to Caracas. All 62 persons aboard were killed. The aircraft had a Dutch flight crew aboard.

The DC-8 fuselage, described by a KLM spokesman as apparently "in relatively good condition," was discovered by divers in shallow water. Attempts to raise it to determine the crash cause were abandoned to begin late last week.

The pilot's post-mortem in the transmission to the Lisbon tower called sharply in maintenance from electronic failure or for other reasons, and there were no mechanical problems in the probable cause of the crash.



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AIRLINE OBSERVER

► U.S. airline interest in the Sud Aviation medium-range Caravelle turboprop transport is no longer spurring. TWA has finished discussions with Sud Aviation in Kansas City (AW June 5, p. 40) and has sent a top-level technical team to France for a further look at the Caravelle. The carrier reportedly is interested in 20 aircraft. Meanwhile, United Air Lines has received the first of its Caravelles and will begin Caravelle service on the New York-Chicago route July 31. Sud wants 125 orders to bank now as the Caravelle project, so far has received 110 firm orders.

► Watch for Air Traffic Control Act, which recently demanded the suspension of its third executive director in the last five years (AW Apr. 24, p. 41), to elect the office by constitutional amendment. Disturbed by confusion as Federal Aviation Agency's Region 3, the amendment proposal would substitute a paid president for the executive director to avoid "any more executive director-president-office-transfers." Candidates plan to file their amendment petition before Aug. 30.

► Los Angeles Airways will be forced to lease its initial order for Sikorsky S-611, two-turbine helicopters to lease instead of the five originally planned (AW Apr. 10, p. 42). The carrier's debt-ridden state will limit its lease on aircraft from the kind of America to \$1,500,000, thus restricting the equipment purchase. Sale of additional aircraft stock is under consideration to expand the carrier's capital structure. This could provide funds to finance the S-611 on order.

► Moscow's diplomatic community was treated to a rare sight earlier this month when Indonesia's President Sukarno flew into Vancouver. Moscow's international airport, shared a Pan American World Airways Boeing 707 turboprop transport under the most of seven Soviet jet fighters. The Pan American Boeing, which served as a backdrop for Soviet announcement of the personal meeting of Sukarno by Soviet Premier Nikita Khrushchev, was chartered by the Indonesian president. Soviets reportedly made unofficial attempts to persuade Sukarno to use a Soviet transport for the trip into Moscow, but Sukarno held to the American charter.

► Look for Pakistan Airlines to purchase about 15 Martin 404 transports from Texas World Airlines if Civil Aeronautics Board grants Pakistan's petition for routes between Atlanta and Baltimore, Atlanta and Charleston, Kansas City and Asheville, N. C. Initial cost has virtually ruled out buying more than 10 747s to replace the 12 Douglas DC-8s now operated by Pakistan. The last 10 of TWA's 49s were retired April 30.

► Double employment rate sought by British Overseas Airways Corp. as its wholly-owned subsidiary, British West Indian Airways Corp., as a new franchise is moves by the island of Trinidad and Tobago to take over ownership of BWIA (AW June 12, p. 42). BOMC, concerned over BWIA losses, seeks to eliminate its share in 400 BOMC employees in the West Indies, where unemployment already is a severe problem.

► Trans World Airlines has decided to equip its turboprop fleet with Collins Distress Measuring Equipment as an effort to comply with Federal Aviation Agency's proposed June 1, 1962, regulations deadline. About 10 DMEs are manufactured by Federal Electronic division of International Telephone and Telegraph Co. have been indicated by TWA, which intends to off them to American Airlines.

► British Royal Aircraft Establishment at Farnborough is cooperating with the French ONERA research organization in designing a supersonic transport in the Mach 2.0 plus category. M. J. Lightfoot, RAE director, and design in progress is aimed at transatlantic operating costs comparable with current large jet transports.

► Cessna has sold 51 location north of Sealed World Airlines debentures, to finance all its holdings in the airline. Debentures were purchased by major Sealed Airlines in part of the company's recapitalization and refinancing plans begun last year.

SHORTLINES

► Air France will operate weekly non-stop Caravelle service between Geneva and Algiers from June 26 to Oct. 8 to handle peak summer travel. Winter season flights will stop at Lyon.

► Alitalia, the Italian airline, reports its traffic across the North Atlantic increased 93% in May and 101% during the January-May period over the same period last year.

► All Nippon Airways has received the first of six Viscount 810 turboprop transports ordered from Viking-Aero-Strang. The airline, serving its routes with two de Havilland 744s, also has six Fokker F-27s on order.

► British Overseas Airways Corp. has notified closed-circuit television at New York, International Airport, to brief pilots and crews on international weather conditions.

► Civil Air Transport of Formosa has received a Cessna 380M turboprop transport and expects to have the aircraft in service between Taipei, Tokyo, Seoul, Manila, Hong Kong and Bangkok by July.

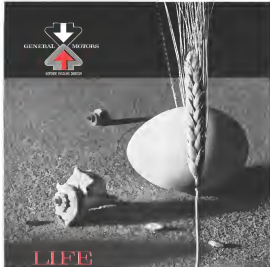
► KLM Royal Dutch Airlines has ordered a Zurich-Casablanca-Las Palmas-Condor-Moscow service to Amsterdam, Ghana, and has increased the flight service to two flights a week. KLM also has introduced the Alitalia on its Zurich-Toronto-Airbus route.

► Pan American World Airways is helping to finance a new hotel in Frankfurt, Germany, which will cost \$10 million, approximately 1,000 guests and be completed in the summer of 1963.

► Middle Airlines will expand its fleet of Douglas DC-7Cs by purchasing three additional aircraft from Northeast Airlines. Converted to DC-7C1 configuration for Douglas, the aircraft are scheduled for delivery this month.

► Southern Airways reports it carried 51,558 passengers & 6,000 cargo passenger miles during May, an increase of 8% over the same period last year.

► United Kingdom Airlines Inc. are expected to make a successful effort to get preferential support in Europe. London's Croydon Airport, now closed as an economic success, has been developed as a business aircraft airport under the plan at Titford, N.



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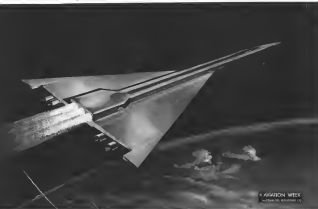
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AVIATION WEEK
JULY 18, 1981

DIFFERENT IDEAS have been expressed as how Aerospace Plane will be propelled and how it will gather air for storage, but the aerospace design will follow principles developed for hypersonic flight which will use superheating effects and aerodynamic reactions to prevent stall and lift, drag and heating. Air Force originally designated the aircraft Space Plane.

Space Plane Grows Into Family of Concepts

By Larry Rooda

Washington—Technique of achieving orbital flight in a single stage from the surface of the earth with an air-scooping vehicle has spawned recently critical feasibility studies and has grown into a whole family of concepts from what originally were a few isolated approaches aimed at avoiding the use of multiple boosters.

A series of parallel studies over the past few years, all based on the principle of air recovery and storage for propulsion coupled with rocket-assisted flight in the atmosphere, are now being evaluated by the Advanced Research Projects Agency for the direction of defense research and engineering.

Space President John F. Kennedy has cosponsored the National Aerospace and Space Administration to an all-out effort to beat the Russians to the moon, and NASA itself has devoted some of its effort to the multiple stage launch vehicle

approach, the Defense Department is the principal U.S. agency interested in the air-scooping vehicle as an alternate possibility.

What the Air Force at first called Space Plane (AWO Oct. 31, p. 20), and later Aerospace Plane, is really a number of different proposals employing a variety of propulsion forms, flight profile techniques and vehicle designs.

High Industry Interest

Interest generated by the air-scooping vehicle is so great that leaders have been co-opted by every major aerospace and aerospace contractor, and many smaller companies have submitted their ideas to the Defense Department.

A few studies have been funded by ARPA and the Air Force, but none has been company-financed with a view to capturing business a decade from now. The great number of ideas developed has helped put somewhat of a damper on the tendency toward any single

single approach along a single line. Scientific and technical officials concerned are careful to point out that the final answer will depend on additional applied research, costs of step-by-step development and coordination of work as a wide variety of fields. These include hypersonic aerodynamics, dynamics of rarefied gases, advanced chemical and electrical propulsion techniques, accurate orbital space navigation, thermodynamics and the life sciences.

With so much interest shown by industry and with the Air Force taking a bigger civilian role in space, including manned missions, the single-stage-orbit concept was subjected to at least four feasibility studies matching it to all facets of the state-of-the-art by ARPA and its parent Office of Defense Research and Engineering since last year. Attempts were made to discredit the idea, but they failed.

The principle of the air-scooping vehicle is based on collecting air at high

altitudes, compressing and liquefying it, separating the oxygen from the nitrogen and then burning the oxygen with liquid hydrogen stored in the vehicle between tanks.

Since it takes eight times as much liquid oxygen as liquid hydrogen by weight to supply the proper stoichiometric combination, the vehicle could takeoff at about half its upper atmosphere flight weight. The weight of the oxygen in the vehicle could be from 40 to 80% of the total propellant weight after collection.

Presumably, this type of vehicle would be able to take off from an ordinary runway, fly to the upper atmosphere, take on a load of oxygen and then act as an orbital tanker and supply oxygen for other vehicles or proceed on its own mission to a soft landing on the moon and return. Not much complexity is claimed as a possible vehicle for traveling to other planets, but as a near-term launching platform it appears promising.

The complexities of the vehicle it will and its subsequent vehicle losses, currently estimated, and even space thermal-control with the operating environment are estimated variables in an order of 100 to 1,000 times as difficult to solve as the World War II Manhattan Project which produced the atom bomb.

Data From Other Projects

As specific project planning out of the studies will depend on the kind of orbit gained in some aspects from other projects. The two which will give the most information are the X-15 supersonic research aircraft which has flown 5,007 mph and the DynaSoar hypersonic long-range vehicle. DynaSoar, which will be launched by an external rocket booster, will operate in the atmosphere expected at hypersonic speeds.

Proposed boost, driven generally into four types of flight for the air collection cycle. Propulsion propels the mass of nitrogen, turbo-motors, which use low-temperature, open-air-scooping, hypersonic flow through, liquid rocket closed cycle engines, liquid rocket fuel sources and electric arc, ion, photon and magnetohydrodynamic accelerations.

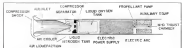
Power supplies suggested vary from batteries and solar collectors to various forms of nuclear fusion and fusion power systems. It is also suggested that power could be obtained from re-radiation of discarded air molecules in the atmosphere.

Simply multiplying the four types of flight by the variety of acceleration and location indicates how many ways there are to design a vehicle.

One approach for collecting air is to enter aerodynamic flight at hypersonic



AIR SCOOPING vehicle around system would have the air scoop, a condenser, an oxygen-nitrogen separation plant, oxygen-nitrogen separation, electric power supply, oxygen and nitrogen storage and a propellant unit. One proposed vehicle looks like this during.



INTERNAL components of an air-scooping vehicle which would use magnetohydrodynamic acceleration would be arranged as shown in above diagram.



CRYOSTAT method of air liquefaction uses successive stages of compression and cooling until liquid oxygen is formed. If separated, liquid nitrogen, which condenses at a lower temperature, can be produced. Problem of heavy equipment must be overcome.



MAGNETOHYDRODYNAMIC acceleration is the concept closest to practical application for orbital and space propulsion. Nitrogen is heated by an arc and passes into a chamber, where an electric current passes through it and a magnetic field accelerates it to produce thrust. Ambient MHD acceleration might operate at 4,000°C.

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INLET at left shows the scoop shape used about 100 miles orbit in gathering cycle, sweeping between 210,000 and 240,000 ft altitude. Conical inlet shape would be the operation in a circular orbit from 125,000 to 160,000 ft. Both of these would operate in regions of continuous air flow. Configuration of inlet at right would be for operation above 110,000 ft where there is molecular air flow. Air would be gathered by adhesion, and power would be provided by a solar collector system.

space between 100,000 and 120,000 ft altitude. The scoop shape least for reconnaissance flight is about 150,000 ft.

At these altitudes, the drag produced in maintaining lift and by the air scoop would require high engine thrust. That the air sweeping cycle would have to be short because of limited fuel endurance. The flight profile would also require a high capacity internal power supply to operate the air collection plant.

Because of the high thrust required combined with the problems of heat dissipation from aerodynamic heating and operation of the power supply and collection plant this method has lower advantages than the others.

A second approach involves an elliptical orbit whose perigee would be about 120,000 ft. During flight in this region, say from 160,000 to 250,000 ft, there would be a concentrated period of air collection. The scoop would be a straight cylinder.

As with the first concept of collection at 100,000 to 120,000 ft, the power requirements for the collection period would be in great part whatever power supply system was used, it would be prohibitive, however. This could be bypassed, reduced from solar collectors, from fuel cells or from nuclear power units.

Circular Orbit Concept

Aerobionetics, which has survived some feasibility studies in use which provides a circular orbit between 125,000 and 160,000 ft.

This vehicle could operate from a nuclear power supply, supplying the entire system by channeling storage batteries and using heat sinks to capture heat generated by the concentrated sweeping cycle.

At these altitudes the design of the vehicle and the scoop are highly critical, because pressure variations along the side walls would cause undesirable high

drag. For this reason the scoop design would be more of a tapered shape.

These three schemes are predicated on continuous flow of air over vehicle and scoop surfaces. Above 160,000 ft, the continuous flow begins to change to molecular flow so that air sweeping is no longer possible.

There is another concept which would provide collection of air molecules by adhesion in a circular orbit or sub-orbit. This would operate in the region above 150,000 ft. Its shape would be dictated by its solar collector power supply. It could be aerodynamic in the high orbit carry a solar collector surface which would be attached when orbit is achieved.

Collection Cycle Propulsion

Each of these concepts demands a certain amount of propulsion during the collection cycle, and all combustion engines proposed would burn liquid hydrogen and oxygen or liquid oxygen. During its development lift, which is now more than 30 wt, the fueljet has

permitted its capability from subsonic flight to the region of Mach 3. The thrust is its power from one g to Mach 7, but must be accelerated to its starting speed, so it cannot be used for takeoff.

A combination of the two, called the turbojet, can the thrust placed by liquid fuel jet engines for takeoff and high power requirements to Mach 3. This is a solid aspect of a fueljet with no drawbacks. When the conventional high speed units are needed in the rocket it could be closed off and the thrust would be able to function up to Mach 7.

The air sweeping at 100,000 to 120,000 ft, the jet would provide the horsepower needed. This would require one of its considerable amount of the stored liquid hydrogen and would reduce the period for orbital flight or transfer to another vehicle.

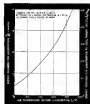
The pump from horsepower flight speeds to the speeds needed to achieve orbit requires different propulsive techniques.

Rocket Unconventional

The most obvious method, and one which is available now is the rocket motor system. This would be unconventional, however, in that it would need liquid hydrogen and liquid oxygen for operation. That taken with an appreciable load of liquid oxygen would be required, or a pump would be necessary along the way to scoop in sufficient air for the next cycle orbit.

A simpler concept is within the view of the air, however. The present rocket reduces air flow into its chamber to subsonic velocity, no matter what the external speed is. A theoretical alternative has a vehicle that has been some research and a little development in the stage which uses supersonic internal flow.

Considerable work would be necessary in the domain of supersonic flow properties. If it were provided a

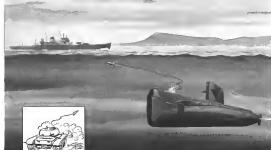


INLET required for air injection from atmosphere at or below injection at indicated time.



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ALTITUDE has some effects on cruise velocity, as shown here. The scale at right shows the cruise speed of a vehicle at an orbit of 5,000 mi.



VAPOR pressure of oxygen and nitrogen versus temperature is shown. Viding points of several solvents are included.



MAXIMUM amount of heat that can be stored per unit surface area of bodies has some versus thickness of heat sink is reflected in the above chart.

space, extensive development programs for supersonic flow target is considered capable of success. Instead of being limited to Mach 7, it could generate the capability to overcome the 75,000 ft/s would be achieved flight.

Once orbital flight is achieved at an increasing altitude, it is considered economical to have the aircraft not be populated rather than being fired. The system closest to practical ap-

plication for flight beyond orbital speeds is the magnetohydrodynamic accelerator. This device would require storage of liquid nitrogen in addition to liquid oxygen. However, an injection system can easily convert both from an MHD would also require a nuclear power supply.

The magnetohydrodynamic accelerator uses the principle of superheating a gas to the point where it is ionized, and then accelerating it with a magnetic coil. In ground test installations these gases can be heated to 15,000°K. The gas could reach the engine walls, but it is kept away from them by the magnetic field.

For a light propulsion, a low temperature MHD accelerator, operating at about 4,000°K would be practical. The nitrogen would be introduced part in electric arc which would heat it. An electric arc vapor such as sodium, sodium or potassium, 150 by volume, would be introduced to make the gas a better conductor of electricity.

It would be checked in a number of aspects: it is a low supersonic speed, thus just past the entrance to an acceleration chamber which can be either a cylindrical or a rectangular cross section duct. Fluid will then produce a magnetic field across the duct. A direct current is passed through the gas between electrodes and in the presence of the magnetic field this current produces a force which accelerates the gas, then producing a thrust.

A theoretical device which might be applicable is the ionospheric target. This is a cluster of particles and ions from the sun, upper atmosphere molecules are dissociated, or ionized. This state requires stored energy. If the ionized air can be properly gathered and converted energy in the form of heat will be released. In theory, a continuous supply would operate without fuel, using only the energy stored in the upper atmosphere. If developed, it could readily be applied to a space plane.

Another possibility besides the MHD accelerator for reaching the moon is continuous amount of fuel, would be use of a variation of the rocket. When used to launch orbit and gain speed, the rocket fuel can be recycled. Then it could be operated by introducing gaseous oxygen, which would burn with liquid hydrogen spewed from the thrusters. One company claims this method is the most realistic complex planning of new rockets.

The four types of air collection flight vehicles are not as different as they seem for doubling their weight. The 100,000 to 150,000 lb craft would have the extreme aerodynamic in loss, but it would be hampered by its achieved del-



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surface. The elliptical orbit method could be on the order of hours also, but it is considered economically unfeasible.

Clearly, while using nuclear power, the best method of collection from the standpoint of economics. The collection cycle would be in the order of days, and it could be repeated many times.

The vehicle in the upper reaches of the atmosphere where there is molecular free would probably be unmaneuverable and capable of operating for years.

Without considering development expenses, proponents claim that the cost of launching Atmosphere Plane collectors would be about \$100 per pound, much less than the cost of rocket boosters available now.

One of the problems which will try the skills of thermodynamic engineers will be the liquefaction of air and its separation into nitrogen and oxygen.

An existing air liquefaction system must be at a pressure of 10 atm. at a rate of one and a temperature below 60°K. In the ordinary cryogenic method of liquefaction, successive cycles of compression, cooling, reexpansion and cooling are used. This is a mechanical system, requiring moving parts and complex plumbing and cooling equipment. It runs on heavy.

Other methods of compression are

Landing of Lunar Vehicles Studied

Safe lunar landing areas will be the craters, mesas, and the most dangerous would be the slopes of craters, according to N. A. Wolf of the Ames Research Foundation.

Wolf says landing a manned vehicle or an unmanned package on crater slopes could set off a disastrous dust explosion. Crater rims and highlands are likely to be hard rock, he said, but dust up to a thickness of several hundred feet may be encountered on crater floors. Wolf discussed these factors in a report prepared for the first lunar national Conference on the Mechanics of Soil Vehicle Systems, in Tucson, Ariz.

Wolf outlined three moon landing alternatives for both manned and unmanned packages.

• **Lunar soil**—scramble smoothly and ride open, and comparatively easy to reach without a precise control system. Vehicle could settle into the dust dune, with the landing retrograde rocket cushioning some of it.

• **Crater floors**—good landing area because the vehicle could be "avalanched" by the dust dune before.

• **Highlands**—vehicle landing on the exposed rock would entail the loss of much of the vehicle, the highlands make up only a small portion of the lunar surface. Guidance problems for

being developed, however. Various areas of cooling shock waves can be used for compression, away from the electric spark.

To separate oxygen from nitrogen, if both are to be kept in liquid form, a centrifugal separator, similar to a cream separator, must be used. If oxygen alone is to be kept in liquid form, it alone can be liquefied near its boiling point of -183°C. above that of nitrogen, which is -195.8°C. Oxygen that will liquefy first in the cooling cycle.

For short-term operations, fuel cells offer an attractive method of providing electrical power. In this method, the fuel is converted directly into electrical energy, by electrochemical means.

The longer term operations, coupled with heavy power demands, a nuclear power source is required. Study development in this line, such as the Suez series, promises lightweight space power systems.

Present conceptions of the robot space vehicle show aerodynamic surfaces with blunt trailing edges. Techniques for constructing the atmosphere have yet to be tried. Two steep re-entry paths would leave the vehicle too close to the surface to allow it to escape again, with the necessity of having to use power to return.

this alternative are difficult and the weight penalty for a hard surface landing is high.

• **Slopes**—control with dust in a constant state of downhill migration under the pressure of reflected sunlight, solar proton bombardment and lunar gravitation. Any individual disturbance, such as seismic activity, impact of large meteorites or landing instrument package, might set off a large dust avalanche.

Wolf said crater bottoms probably are filled with dust dunes, which may be more compacted in the lower layers. He said crater bottoms may be hard because of the weight of the upper layers, lack of electrostatic charging and absence of gasses or liquid lubrication. Bottom layers may be cemented by moisture, evaporating north from rejected meteorites, he said.

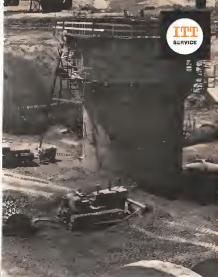
Lunar dust is likely to consist of anhydrous and anhydrous silicate and anhydrous oxides. Fine dust, Wolf said, is at least 40% silicon dioxide interspersed with anhydrous particles from iron meteorites.

Wolf also summarized the probable surface conditions of three terrestrial planets.

• **Mercury**, which has a rugged, dark-colored surface with an atmosphere of 0.2 mm. of mercury. Semi-circular ridges hold shallow pools of zinc, tin or



• Federal Electric Co. system provided F-4 guidance on trip, assets would not be lost, possibly very much more of the cost of the system by F-4.



operational readiness of the TITAN system has been assured by Martin Company's comprehensive planning for electronic technical support.

• The hard base TITAN complex at Larson AFB, Moses Lake, Washington, is now being activated by Federal Electric Corporation. Service Associate of International Telephone and Telegraph Corporation.

• TITAN prime contractor, the Martin Company, is calling on FEC for:
 • Installation and test of Martin furnished TITAN ICBM's and ground equipment
 • Interim operation • Support services for other contractors on the site
 • Assistance to Martin in turning the complex over to the Air Force.

• This company was chosen to activate TITAN Base F-4 because ITT Service demonstrated to Martin system managers that its management, operation, maintenance and support would be effective, economical, and instantly responsive to program needs.



FEDERAL ELECTRIC CORPORATION

Service Associate of International Telephone and Telegraph Corporation
 Paramus, New Jersey

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reporting
from
TITAN
base T-4
...to military
system
managers





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a
life
line
to
earth
for the astronaut...

silicon. Duct layer is thin, probably about 4 in.

• Venus has a 180°C temperature, but is in an atmosphere with a surface temperature of 1,100°C. Atmosphere probably is composed of carbon dioxide, carbon monoxide, nitrogen, methane, oxygen and possibly sulfur. Volcanic storms and deep dust beds characterize the surface.

• Mars' surface is dry, down land consisting of granulated or gravelly, iron rock. Thin layer of nitrogen covers 25% of the surface, and then ice cap on both poles. Atmosphere is 0.1 the density of the earth's, and probably consists of nitrogen, carbon dioxide, carbon monoxide and noble gases.

System Devised to Map Moon's Gravity Fields

Measuring device to map gravitational fields of the moon or planets with homing atmosphere has been proposed by Ames, Inc., Redlands, N. C.

Based on the scheme in the Massachusetts Institute of Technology report, a homing atmosphere is produced by firing a high velocity rocket, speed. This device, which has been used to make libration measurements of the gravitational field of light, has been adapted to a similar concept in the moon mapping instrument.

Ames proposes that the ionosphere gamma radiation be used with a superimposed doppler effect to determine frequency shifts caused by differences in the lunar gravitational field. The first two a movable center of the gamma radiation, a nonradioactive aluminum oxide of the same material in the center and a radioisotopic detector.

The gamma source, Cobalt 57 of approximately 85 curies strength, would be mounted at the rim of a rotating wheel with a turbopropeller drive. The basic frequency distribution pattern at the wheel is then a known shift of the doppler effect on the single frequency gamma radiation.

The absorber is placed some six miles distance away and receives the frequency modulated radiation. The difference between the weakest radiation and the strongest frequency of the absorber determines the intensity of the received radiation and gives the data, the frequency shift.

Emitter and absorber would be kept at the boiling point of liquid nitrogen for two reasons. First, radiation frequency is dependent on temperature. Low temperature have least effect on the frequency. Second, temperature of absorber and source can be regulated by control of the nitrogen pressure.

Total power requirement for the system is estimated at about one kilowatt.

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When developed, the TYPHON weapon system will provide the fleet with greatly improved defenses against enemy submarine weapons, plus longer range attack capabilities. The system is designed to simultaneously handle a larger number of targets than ever before possible.

Recent of the TYPHON system will be an advanced, long-range search, track, and missile guidance radar that will be designed, developed and produced by the Weapon Systems Department of the Westinghouse Baltimore Defense Division, under prime contract to the Bureau of Naval Weapons. The TYPHON program is under the technical direction of the Applied Physics Laboratory, Johns Hopkins University.

Westinghouse contributions to TYPHON are the result of many years of experience with such basic elements as radar, computers, airborne guidance and control, and search and tracking systems.

TYPHON is another demonstration of how science and systems engineering capability are serving Defense at Westinghouse.
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Washington 6, D. C.

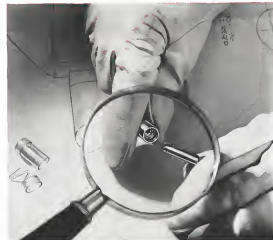


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Westinghouse



NEW DEPARTURES IN MINIATURE




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The bearing illustrated is an NFD linear motion precision instrument ball bearing. It was specially designed and built to help solve a critical problem in the guidance system of a high speed anti-submarine missile.

PROBLEM: Loss of accuracy in Topper's guidance system due to hang-up of caging and
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SOLUTION: NVD Sales Engineer, in cooperation with manufacturers, will first meet of bearing on capsize, etc. caused from a driving performance activities. NVD Engineers will work to design and build an instrument bearing that operates virtually flawlessly. The result: Protection of the guidance system's pinpoint accuracy and reliability.

Should you require ball bearing design information, invite the local NVD Sales Engineer to participate in a free, early design discussion. His reports come from the Study's largest engineering staffs devoted exclusively to the design and development of miniature and instrument ball bearings. Or, write for our Miniature and Instrument Ball Bearing Catalog, Department L.S., New Department, Division of General Motors Corporation, Detroit, Connecticut.



This special M/D linear motor has built-in ballbearing increases guideway reliability at ASTOR Turbine weapon system developed by Westinghouse.

NEW DEPARTURE

that the flight environment was very close to the environment provided by the controls. The flight attributes were smooth at the same magnitude and during transition and certainly no way disturbing.

[illegible]

Most Valuable Add:

These three men then, the controllers, the procedure trainers, and parents taking it the housing was, provided the most valuable aid during the housing period. We quit two more in housing *long* many things, following many services in our design to be sure that we had not overlooked anything at any house. As a general constant monitoring before leaving, prepare these operations will undoubtedly prove us to shorten the housing period.

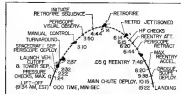
During the three months immediately preceding the launch, the perfloured polyurethanes were used. These compositions do not involve

From the first preliminary interviews, and other medical tests, I'd hope that breast lumps should samples are required in the future, I felt it through an unusual number of needles were still.

Single hearing was held at 11:00 a.m. on the day before launch to correlate all operational elements. The briefing was helpful since it gave us a chance to look at medical, radio, customs, and recovery team status. We also had the opportunity to review the normal procedures to be used during flight emergencies as well as new line

inputs of an operational nature. This being very often extremely valuable to me as covered me all of the details on the last account.

I include as part of the flight period the time from emergence into the open to the appearance of the first egg masses on the apocarpae on the bunching pad until the time of oviposition by the helicopter. The cause and operational procedures described during the study preceding the launch were essentially sound. The countdown went smoothly and no major difficulties were encountered with the ground crew, the centralizer crew, and the pilot. There has been some spec-



TIME SEQUENCE of Col. Alan B. Slaughter's MRE 3 Sight (AW May 15, p. 31)

went as the press shot the length of time spent in the spacecraft prior to launch, some 4 hours and 11 minutes to the event. The period was about two hours longer than had been planned. A fact that is most encouraging is that during this time, there was no significant change in pilot alertness and sleep. The anomalous period, from the viewpoint of the flight, was not a problem. The astronauts appear directly to be operating orbital flight, and we are approaching with greater confidence in the ability of the pilots, as well as in the environmental control systems.

Our plan was for the pilot to report to the blackhouse crew promptly prior to T-2 minutes on lead way circuit, and he then proceed to the C-130 to see all radar frequencies at T-2 minutes. (The weather

to turn to left-of-center! This link worked smoothly and continuity of submission to the pilot was good. At 10:45 I started a discussion on the spectrum and prepared for some rebuttals. I left none of my inner companions. The subject arises or pretends so often and I did not even have to turn up my radio receiver to tell anyone to leave the radio (intercom). Radio communication is so useful after all, and then periodic transmissions were made, at 15 second intervals for the purpose of monitoring voice content and of report on vital information to the ground.

Camera Orientation

The particular device introduced during my flight happened to include many clouds. Photography shows the contrast between land and water means the cloud cover and its effort, and a good view of the horizon. There appears to be a haze layer of the horizon. This haze is a function not only of particles of dust, moisture and so forth, but also of light refraction through atmospheric layers. The sky itself is a very deep blue, almost black, because of the absolute lack of light reflecting particles. We are encouraged that the previous, provides a good viewing device as well as a heading, attitude-control indicator and navigation aid.

At about five p.m., as I have indicated publicly before, I realized that something would not run about weightlessness. I use this example again because it is typical of the lack of anything sporting during a weightless or strong environment. Movement, speech, and breathing are awkward and the entire situation is most awkward.

LORAN-C RECEIVERS

NOW IN PRODUCTION

Airborne

Sperry now offers airborne Loran-C receivers—the only airborne system in production today. Providing extremely accurate position determination—by measurement of the interval between radio pulses from "master" and "slave" Loran stations—these receivers will contribute importantly to advances in air traffic control and navigation, early warning, air-sea rescue, test range instrumentation, mapping and surveying, and many other applications. The rugged, lightweight, automatic direct-reading system consists of a control unit and indicator at the control station, plus a synchronizer used as a remote indicator, providing installation flexibility.



Shipboard

Now in production, Sperry's shipboard automatic direct-reading Loran-C receivers offer the finest and most accurate system of long range marine navigation. Other applications include all those shown for the airborne receivers above, as well as pocket ships, underwater cable installation and other specialized tasks. Both the airborne and shipboard systems are ready to go to work with the established and growing Coast Guard network of Loran-C transmitting stations. Both are designed to meet specifications of both Bureau of Naval Weapons and Bureau of Ships.



SHIPBOARD MODEL

SPERRY

AIR ARMAMENT DIVISION, SPERRY GYROSCOPE COMPANY • DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, N.Y.



MINIATURE model of Loran receiver measures only 1 1/2 by 2 1/2 by 1 1/2 in.

Using passing through the coil to the detector will be at a minimum.

Additionally, the procedure of locating the RF frequency which produces maximum absorption is accomplished automatically by means of a phase detector which controls the oscillator producing the RF field around the coil.

Because the frequency of the received wave is directly proportional to the magnetic field to which the coil is exposed, field strength can be read out directly in digital form from the oscillator's output. If an analog output is needed, this can be provided by means of a frequency discriminator circuit.

The induced beam to excite the helical antenna in the absorption cell is obtained from a highly helical loop, coated from the same feed frequency source used to produce a discharge in the cell. The frequency of RF energy needed for the lamp is not critical. Present models operate at about 50 mc (the induced current by the helical loop is focused and collected by means of a lens and a circular plate).

A more detailed explanation of the helical magnetometer's principles of operation involves the helical antenna and its several energy states and energy levels within these states. The lowest energy state of the helical antenna, called the ground state, is the natural one where there is no external source of excitation for the atoms.

When the helical antenna in the absorption cell is excited by the 50 mc (50 mc frequency) source, the resulting discharge causes a flow of the atoms from the ground state to the intermediate excitable state.

There are three energy levels at the excitable state. These are known as $m = -1$, $m = 0$ and $m = +1$. When the helical antenna moves up from the ground state to the excitable state, the largest number will assume the $m = -1$ energy level, the lowest number will assume the $m = +1$ level, while the $m = 0$ will have a figure somewhere between these two extremes. The difference between each two adjacent energy levels corresponds to 2.5 mc. When the helical antenna is exposed to a one gauss magnetic field.

When the induced loop is moved



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FROM ITT'S PAST—TOMORROW'S ANSWER TO COMMUNICATIONS

UNDER ANY CONDITIONS

Consistent with its policy of thinking and working years ahead, ITT Federal Laboratories has been concerned with the communications problems which might arise in extreme emergencies. That, surely, is when the need for rapid interchange of information would be greatest, and where the system and equipment would have to be absolutely reliable.

Providing airborne guidance and communication systems, capable of outstanding dependability under even the most unfavorable environmental conditions, is a significant aspect of ITT's past and current record. Instrument landing systems, direction finders, distance measuring equipment, and guidance systems for some of our most successful missiles are but a few of ITT's developments in this field. Today, Company-sponsored research activities responsible for many of these accomplishments have been greatly expanded to anticipate the increasingly critical communications needs of the future.

To the military and to industry, ITT Federal Laboratories offers a unique combination and continuity of skills, already existing as a highly trained team, for performance of complex projects throughout all stages from original concept to the delivered system.



FEDERAL LABORATORIES
500 WASHINGTON AVENUE, MOUNTAIN VIEW, NEW JERSEY
BRANCHES IN NEW YORK, LOS ANGELES, SAN FRANCISCO, PHOENIX, AND
SEVERAL INTERNATIONAL LOCATIONS ARE AVAILABLE

on, and its beam is focused on infrared stores in the absorption cell, those which have been cooled to the metastable state by the previously mentioned discharge across the cell will absorb infrared energy and be elevated to the highest "P" state, which also has three different energy levels.

But the "P" state is a transient one and drops directly to the stable quickly fall back to the metastable state. In so doing they radiate the infrared photon energy which has earlier had absorbed that the infrared energy is radiated in all directions so that only a portion of it reaches the infrared detector.

If the helium atoms in the cell are now exposed to an RF field, a nuclear phenomenon known as the Zeeman effect occurs. As previously mentioned, the difference among the three energy levels of the metastable state is a function of the magnetic field to which the atoms are exposed. As the oscillator frequency nears the resonant frequency for the particular magnetic field in which the atoms are exposed (12.5 mc per gauss), atoms at the energy level of $m = +1$ will absorb additional energy from the infrared beam and move up to the energy level $m = 0$, while those atoms at the $m = 0$ level will absorb infrared energy which elevates them to the $m = -1$ energy level.

When the oscillator is tuned to the resonant frequency which corresponds precisely to the magnetic field in which the atoms are exposed, the maximum number of atoms will be elevated from the infrared beam, and the infrared detector's output will be at a maximum level.

At such time, the oscillator frequency will be directly proportional to the magnetic field which is to be measured.

One currently available model of the new Trans Instruments helium magnetometry sensor, measuring the bright helium lamp, crystal oscillator, absorption cell and infrared detector, measures 11 x 7 x 7 in. and weighs 6 lb. Another model has been designed in which the sensor occupies a volume of only 4 x 4 x 2 in. A miniature version, which measures only 1 1/2 in. dia. x 1 1/2 in. long, contains both the helium lamp and absorption cell in a single compact package. At present, this miniature magnetometer has a sensitivity of only 0.7 gauss, about 1/10th that of the larger models. (One gauss equals 0.0001 tesla.) However, the company says it believes this restriction can be overcome.

Trans Instruments has delivered experimental models of its new helium magnetometer to several authorized government/military agencies for tests and use in conjunction with experiments with other far-infrared designed for optical remote sensing.

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High-Density Field Telephone Is Tested

Washington-Navy radio-telephone system, which permits one station to call any one of a large number of other stations and carry on a private conversation without subjected interference from other users conducting simultaneous conversations, was demonstrated here by Martin's Orlando Division.

The new system, providing VHF/UHF voice and data service, appears to be well suited for use in a field area where many mobile radio sets, together with those of many forces, are active or ready for field use in the rapidly varied communications. Martin also sees advantages for air-ground communications.

Martin calls its new system Range, a acronym for Random Access and Concentration for Extended Performance. It has limited details disclosed by the company, it appears to be similar to the "spread spectrum" broadband communications technique which has been under investigation by General Electric, Bell Labs, Philco and others. This new technique provides more efficient use of radio spectrum when several calls are in use, it, when over its own previously used with frequent grants to the conversation.

Range can provide 70 simultaneous voice channels (15 full duplex channels) in a 4-mc bandwidth of all spectrum channels without noise. This amounts to 57 db per channel is slightly more than the 50 db was used in conventional spread spectrum systems.

Multiple Conversations

However, because of the need to filtering of conversations without significant interference made possible in Range, it appears possible to accommodate 700 calls in the 4-mc bandwidth (assuming a one factor (about each) of 10% according to Martin).

The system is not inherently limited to two or more other modes. As the number of simultaneous conversations taking place at one instant increases, each set will have an increasing amount of interference noise in the background.

If the number of simultaneous calls exceeds 700 and/or the use factor exceeds 10%, it quickly becomes more difficult for each user to hear the increasing message over the background noise.

For this reason, the system tends to be self-regulating. When the receiver and background noise power, individual users will quickly sense which to improve intelligibility, which in itself will reduce the use factor of any individual and reduce noise. Also, users with low priority messages will tend to be located

disregarded and long up, further decreasing background noise.

Range is reported to operate much like a cellular telephone system except that it requires no landlines or manual changes. Each station is assigned a discrete code (address), equivalent to a telephone number. A directory available to the operator lists the three-character codes of each station in the system network.

Calling Procedures

To call one station in the network, an operator would look up the code of the other and set it into his own transmitter by means of dials or controls. Next, the operator turns a switch in the station being called to five or six, which is assigned to the conversation.

When the station to be called is free, the operator pushes a button which activates an audible visual alarm on the station being called. When the operator at this station picks up his handset, the two are connected as they would in a telephone.

An interesting feature of Range is an overall position which enables a commander at a key station to instantly reach all other stations in the network by a discuss, interrupting other conversations that may be in progress. However, this feature could backfire if in error, instead the command code and

built a transmitter to broadcast it, blocking out conversations through out the network.

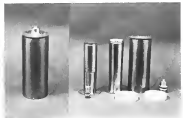
One interesting reason and because Martin has not yet been granted patents on what it believes are innovations in Range, the company does not discuss the principles of system operation.

The speech weakness of the system is simplified and connected to a modified form of public position modulation (PPM). Each PPM pulse is then added to the code for the intended receiving station (as is called by the operator) by inserting it in a group of "sub-pulses." Individual sub-pulses in one group will be transmitted at different carrier frequencies within the five band and with appropriate code time delays between individual pulses.

Time Frequency Matrix

This combination of carrier frequencies of each pulse and time delay between pulses, which Martin calls a "time-frequency matrix," controls the message for the intended station. All stations in the area will receive the pulses, but only the intended recipient can decode the pulses and reconvert them into speech.

At the receiver, each of the sub-pulses in the pulse group is envelope detected followed by a series of complex demodulators and coincidence gates. Martin says. All sub-pulses must be present in



Small UHF Satellite Transmitter Displayed

Compact transmitter designed to generate up to two kilowatts of power in the 160- to 400-mc range of the UHF frequency band (along actual weight on spacecraft) light is contained in a cylinder, 10 in. long and 4 in. in diameter. The outer shell (left) is the power amplifier mount (right). Extending from the top of the cylinder is the power supply unit. The demodulated view of the transmitter (right) shows three cylindrical crystals, two of which are part of the oscillator which make up the transmitter. Manufacturer: Spac Electronics Corp., Chelmsford, MA.

the proper threshold before the full PPM pulse will appear at the output of the decoder. The decoder output is fed to a non-synchronous PPM demodulator which regenerates the original square waveform.

The use of pulses which are very narrow relative to the sampling period permits signals from many different transmitters to occupy the same common frequency channel with only a small amount of cross-talk, Martin says. By using non-synchronous PPM and over-modulated transmitters, a random stacking of noise contributions occurs which gives minimum pulse density and maximum cross-talk, according to the company.

Spectrum Scanner

If users of a radio network called communications, without power or interruption, Rapp would offer little spectrum using over conventional radio systems. In practice a considerable amount of spectrum goes to waste when specific frequencies are reserved for use by stations which need to communicate only occasionally, with additional waste elsewhere in their concentration. Collectively these bands, but frequent, power and spectrum add up to considerable spectrum loss.

Martin's Rapp employs a technique which avoids both types of spectrum waste, allowing communication to utilize "chunks of spectrum" which otherwise would be lost.

Martin says it has been working on the Rapp technique for several years. The program so far has been funded by the company, but it is now negotiating with several military agencies for procurement of hardware for test evaluation, the company says.

Within six months Martin expects to have models of mobile Rapp transmitter/receiver equipment with peak-power output of 1 kw, capable of providing ranges of about 15 mi. for surface use.

Martin demonstrated how over low-power units available only for very short range communications.

Because the technique can be used to provide communications using voice and data communications, Martin believes Rapp has attractive advantages for air-ground use and has held preliminary discussions with the Federal Aviation Agency.

Another possible application, according to Martin, is for mobile guidance where a large number of vehicles could be handled easily simultaneously from the same unit. This specific use requires its own special guidance commands, specifically addressed to its mobile base unit. Because Rapp is non-synchronous, the danger of capture of "hijack" programs in other communications systems is minimized, the firm says.



FEATHER-WEIGHT

ELGIN MICRONICS

Elapsed Time Indicators

Here's some hardware that's designed for high-altitude hitch-hiking—so light the digital read-out unit shown weighs only 1.6 ounces! and so small that they're strictly in the "no problem" category as far as load and air frame space is concerned. And in return for a bit, they give you completely reliable operating time data. There's no better way to turn "down-time" into "air-time" for critical flight systems. Dial as well as digital read-out units are available, AC or DC to suit your or curbs, and they surpass the toughest military requirements easily. Write for bulletin today—ask for ETI 1.

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FFIVE FILTER CENTER

► **Semiconductor Inductance Invented**—Naval Research Laboratory scientists, exploring the feasibility of using the inductance of a semi-conductor diode to produce a sensitive diode inductor, have produced a single film with a "Q" greater than 1,000 using a double-layer diode as a combination with an R/C network. The inductance that occurs in the base region of a forward-biased P-N junction differs from conventional inductance produced by a magnetic field because it appears to be associated inseparably with a series and parallel inductance that limits its inherent "Q" to less than one.

► **Solar Cell Sorter Developed**—Machine which automatically measures conversion efficiencies of silicon solar cells and sorts them out according to efficiency has been developed by Chrysler Corp.'s Muscle Division, Pontiac, Mich. AL, for the George C. Marshall Space Flight Center. Device sorts cells at rate of 12 per min. into six efficiency ranges.

► **RCA Gets New Miss Spectrophotometer**—New miss spectrophotometer designed to sort out and identify one, separately after launch, near this, a follow-on job in only one hour has been delivered to RCA Laboratories for use in materials research. New instrument, built by Britain's Associated Electrical Industries Ltd., is one of the world's most sensitive research tools, according to RCA.

► **Advanced Satellite Telemetry**—Advanced PCM telemetry system, designed to make PCM more versatile, will be developed by Space Electronics Corp. under a \$15,000 contract from National Aeronautics and Space Administration. System is designed to operate over a wide range of data inputs and will have a 10-bit analog-to-digital converter. Important phase of development will center about effort to come up with a small lightweight, low-power analog-to-digital converter.

► **Semiconductor Network Firms to Fall**—Four semiconductor firms, the price of which has fallen since semiconductor networks to drop capacity, in the past several years, are among the proposed firms for conversion to semiconductor networks in 1964. Today, equipment made with these integrated circuits costs five times more than the same unit using conventional components, according to estimates by Texas Instruments Company (AVR June 12, p. 74).

► **Jetel Semiconductor Film Study**—Bell Telephone Laboratories will assist Lear's Solid State Physics Laboratory in an evaluation of diodes and transistors made by Lear's technique of evaporating thin films of semiconductor materials and other semiconductors on dielectric substrates. Lear has, in particular, evaporated germanium films on dielectric substrates for some time (AVR Dec. 5, p. 97), and now Bell Telephone is \$275,000 contract from Lear, will evaluate the quality of devices which can be made by this technique. If diodes and transistors can be evaporated in this way, it would then be possible to evaporate active as well as passive film components in a single dielectric substrate.

► **National Optical Mirror Construction**—James Bridges, director of electronics, Office of Director of Defense Research and Engineering, is attempting to organize a committee within the Department of Defense to coordinate applied research on optical mirrors. The committee would attempt to encourage research on these devices, which, Bridges says, may be one of the most significant electronic developments in 10 years.

► **Superpower Tube Development**—Klonsky, capable of turning out power tubes in the vacuum region in X-ray tubes are being developed by Vetus Associates under a \$500,000 contract from the Army Signal Corps, which has responsibility for research and development of tubes needed for the Army's Nike Zeus and Zenith programs.

► **Continuously Measured Radio-Test Equipment**—Klonsky (Naval) Advanced Radio Test Equipment, which will be integrated into the AN/SPS-10, under the Navy's guided missile system USS Albany was recently delivered to the Naval Electronic Laboratory at Portsmouth. The equipment is designed to continuously monitor the radio and to make malfunctions down to optimum maintenance level, according to the company. Name stems from "Nonintermittent" Detection equipment which will be used in Polaris submarines.

► **New Bright Film Developed**—Westinghouse Electric has produced recently this electroluminescent film, using rare metallic, which can produce a brightness of more than 500 foot-lamberts approximately 10 times the average brightness of a well-lit room. W. A. Thomsen reported during a recent young meeting of the American Physical Society in Washington. The film, only 1/100th the thickness of a human hair, can produce bright visible light emission when excited by as little as two volts.

ASTRONOMICAL SATELLITE



National Aeronautics and Space Administration's Astronomical Observatory will be launched 500 miles into space in 1963. It will orbit above the noise of Earth's atmosphere, which distorts and absorbs radiation from stellar objects. Observations through a 36-in. telescope from this vantage point will provide astronomical data unavailable from any ground-based equipment.

Initial Stabilization—Within five hours after reaching orbit, the Astronomical Satellite's stabilization and control system will eliminate tumbling and roll, and orient its optical axis away from the sun. Reference to a predetermined star pattern will verify initial stabilization.

Accurate Stabilization—Next, the satellite will be pointed and held to within 15 minutes of arc, using feedback from the system's six star trackers. Feedback from experimental optics will then be used to stabilize the satellite within 0.1 sec. arcs of arc.

General Electric's Muscle and Space Vehicle Department is developing the stabilization and control system for the Astronomical Satellite. Similar systems for Atlas and Thor re-entry vehicles, and Advent and Horizon satellites have already been designed by GEV, a department of the GE Defense Electronics Division.

GENERAL ELECTRIC

ASTRONOMICAL SATELLITE will orbit beyond Earth's atmospheric haze—historic barrier to man's study of stars. Once this NASA satellite is stabilized in orbit, its ground-controlled telescopic and electronic equipment can automatically observe, collect and transmit data. The control and stabilization system for this orbiting astronomical observatory is being developed by General Electric's Muscle and Space Vehicle Department for Grumman Aircraft Engineering Corporation, prime contractor for the Astronomical Satellite.

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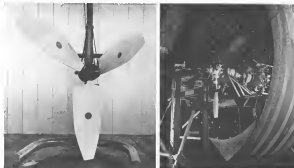
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AERONAUTICAL ENGINEERING



CURTIS-WRIGHT glass fiber propeller is tested in gyroscope wheel rig which induces stresses as exact as actual flight stresses.

Glass Fiber V/STOL Propeller Is Tested

Lowest glass fiber propeller for V/STOL aircraft has been developed and tested by Curtis-Wright Corp.'s Propeller Division.

Blades weigh about half of equivalent hollow steel or solid aluminum alloy blades, the company reports.

The new propeller design is an outgrowth of C-W's work with its Model 106 and 200 V/STOL designs, and has been tested extensively in flight on the Model 100 vehicle. Wind tunnel and simulated flight tests, plus vibration endurance and ground erosion tests have been a major feature of the development program.

Commercial Market

As a result, the company says it is now ready to seek the commercial market for these new types of propellers, described by the manufacturer as lightest known of V/STOL aircraft.

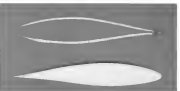
Basic structural material is glass fiber woven with other non-directional or bidirectional fiber construction. Seamless monocoque blades are molded in lengths with a steel blade root for attachment to the hub. Blade is held in the shank mechanically, so that bonding between the plastic and the steel is not critical.

Two fundamental configurations have been developed, sandwich wall construction, generally to be recommended for large blades, and foam-filled, for smaller blades. Choice of the type depends primarily on the specific application, construction type influences both stiffness and deflection of the blades.

Injection technique is essential and involves a flexible bladder, held in a core mold and filled with low density foam. By creating the bladder, the shape can be held after removal from the core mold. This shape then serves as the mandrel for further lay-up of the glass fiber weave.

Alternate layers of various sizes of cloth with uni- and bi-directional fibers are laid up around the mandrel. If the construction is to be sandwich-walled, pickered panels are added during the lay-up.

Blade root area is stress-strained



TWO TYPES of blade construction are shown; sandwich wall construction (top) needed for large blades and foam-filled (bottom) for smaller blades.

MIL/SPEC

GM-07-59-2617A

...Implemented by Capehart's INTERDICTION GROUP

A veritable thicket of specifications has grown up around radio frequency interference measurements. Specification GM-07-59 2617A appears to be one of the thickest. If you are having problems implementing this, or are expending any other effortily collected with RFI, contact the INTERDICTION Group from Capehart.

INTERDICTION (for Interference Detection and Identification by Countermeasures Team) is a unique service. It began with the numerous field studies our engineers were carrying out. It grew into a series of mobile RFI measurement vans, an expanded force of engineers, a manual on RFI protection by mathematical procedures, possession of all current military and industrial communications/electronic equipment, and formal organization into a team led by Dr. Joseph Vogelstein, widely-known authority on RFI detection and elimination.

The engineers from INTERDICTION are completely competent to aid in establishing: systems analysis, design limitations, criteria and test procedures. Follow through by INTERDICTION engineers in the actual performance of these tests assure complete implementation of GM-07-59-2617A, or any other relevant MIL Spec's. They have performed numerous systems and site analysis resulting in the prediction, detection and elimination of interference at such complex sites as Cape Canaveral and Vandenberg AFB, frequently before RFI interference occurred. They can offer you studies of this magnitude, or of very limited application, depending on your needs. INTERDICTION possesses the man, the van, the material, and the experience to analyze a complete proposed missile system, an individual site, or a single piece of installed equipment. The "package" can be tailored to the requirement.

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around the steel disk on a controlled schedule and specified tension.

Special turbochargers—permanently a prominent portion of the power-lighter the them so that the material can be melted free of wrinkles. During a drive in a heated hydraulic press during the cycle, the vacuum in the bladder is regulated with nitrogen under pressure to produce a finished stainless blade.

Studies on lightweight propeller began in 1946, and in February, 1953, the company's designers started work on the stainless blade type. Initial blade was formed in Japan, and the first propeller was steel tested in September, 1953. From October through December, the company installed propeller tests on its group's test rig, which simulates the vibration stress conditions of 9,810 G, aircraft sea puller. First run on the Model 100 VFD, test vehicle began in January, 1959.

Partial effort to propeller development was a materials and process control program aimed at finding stress-vibration and vibration areas limits of the glass fabric material. Fatigue tests, most of which were carried out in 18 million cycles, were made on basic material samples. The blades themselves have been tested beyond 100 million stress cycles.

Carlini Wright cites the usual advantages of glass fiber construction—lower cost because of fabricating technique, lighter weight because of the fiber strength-density ratio of the material, control of size and shape distribution by arrangement of material lay-up, variability, freedom from resonance high damping characteristics. The company is developing gear box built to it demand, and that has electron gear is required for driving because of reduced conductive losses through the material.

Long-range abrasion protection can be provided depending on needs.

Similar approach to the design of helicopter blades has been taken by Kaman Aircraft (AW Apt. 13, p. 47).

Air-India to Acquire Turbojet Test Plant

Air India will have its own turbojet control and testing facilities completed in 1962, according to an airline spokesman.

The new plant will be located in Bombay, will cost approximately \$3,000,000 and will cover an area of 67,000 sq ft. The plant is expected to be able to service engines up to 44,000 lb thrust and will be able to overhaul 18 engines, engines per month.

Reliability is currently problems overall servicing for the Indian carrier.

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In addition to producing operational equipment for today's aircraft, RPI is working on second-generation, unpowered, and other fully automated escape systems. This engineering support is available to help solve your ballistic/rocket problems. Call RPI today.

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Italy, Germany Display V/STOL Mockups at Paris Show

German Focke-Wulf V/S104, mockup shown, displayed at the 1965 Paris International Air Show, has wingtip pods which would contain on left engine covered by panel. Both Focke-Wulf 102 100 engines probably would be incorporated in the design. Citrus drawing of Italy's Fiat G95 V/STOL fighter (AVR May 22, p. 71) below, shows incorporation of additional lift engine. Original plans called for two on the forward fuselage section and two on the A-100 engine has been added to the fuselage center section. Only one of the two main propellers mentioned is shown in the drawing. Plans at Paris entry in NATO V/STOL close-support fighter competition.



Air Force Transfers Top-Level Generals

Washington—Air Force has reorganized several general officers in one of its periodic series of transfers among tactical posts, and following the announcement of Gen. Curtis E. LeMay as chief of staff.

Gen. Samuel E. Anderson, commander of the Air Force Logistics Command, formerly the Air Materiel Command, will become as deputy to Gen. LeMay. Gen. William F. McCreary, now vice commander of AFMCC, will succeed Gen. Anderson.

Gen. Bernard A. Schriener will be promoted to full general and will remain as commander of the Air Force Systems Command.

Gen. Thomas H. London will be promoted to general and will become commander of U.S. Air Forces in Europe, succeeding Gen. Francis H. Smith, promoted vice chief of staff.

Gen. Francis H. Gurnea, vice commander of Strategic Air Command, will become commander of the National War College in Washington. Succeeding Gurnea will be Lt. Gen. John P. McConnell, now commander of the SAC Second Air Force.

Lt. Gen. David E. Sasser, Tactical Air Command vice commander, will

become commander of U.S. Forces in Japan and Commander of the Fifth Air Force.

Gen. Edward F. Timberlake, vice commander of U.S. Air Forces in Europe, will be promoted to lieutenant general and will succeed Gen. London as deputy chief of staff.

Gen. Gordon A. Blake, vice commander Pacific Air Force, will be promoted to lieutenant general and will be assigned as commander of ComUSMACV.

Gen. Gilbert P. Drewson, commander of Force Systems, military studies and liaison division of the Weapons Systems Evaluation Group, will be promoted to lieutenant general.

OVER AND UNDER THE TOP OF THE WORLD

In early 1960, American craft pierced the North Pole in two elements. Fifteen miles below solid ice, the USS Sargo probed seemingly to "90 North"; miles above, a GAM-77 missile on a B-52 pinpointed the featureless goal. Both used Inertial Navigation systems by Autonetics—where today's results pave the way for tomorrow's breakthroughs.

Electromechanical Systems by **Autonetics** Division of North American Aviation

and become vice commander of Task Force 10.1. General
 Maj. Gen. Kenneth B. DeLoach will be promoted to lieutenant general and will be assigned as vice commander of Air Force Logistics Command. Maj. Gen. Thomy Mills, Jr., vice commander of the Air University, will be

promoted to lieutenant general and will become commander of the university. Maj. Gen. Robert H. Treadwell, now commander of the Air Force Ground School, will be promoted to lieutenant general and assigned as vice commander of Air Defense Command.



Model of Convair two-place DFS 582 present globe is displayed at Paris Air Show.

DFS 582 to Have 4-hr. Endurance

Para-Production models of West Germany's two-place DFS 582 high-altitude powered glider, the equivalent of a small jet, Lockheed U-2 (AWN 28, p. 26), are now under construction at Wörring Flugzeugbau in Bavaria.

Designed by Munich's Institute for Aerodynamics, the aircraft are on order to the West German Ministry of Transport and are officially said to be designed to conduct high altitude weather and military reconnaissance.

Design specifications call for the DFS 582 to make a powered climb to 50,000 ft within 10 min and to have a non-powered faster climb rate of 10,000 ft per min. For descent there is 30 min. The aircraft's 3,000 lb. (1,360 kg) weight (T132A) is to permit the pilot to make a powered approach at landing. Most wing area is 1,800 sq ft.

The T132A is based on the new landing system. An inlet duct located on either side of the fuselage just in front of the wings is extended during powered flight, retracted during the glide phase to obtain better wind-tunnel flow.

With a maximum gross weight of 4,180 lb., the DFS 582 has a maximum payload of 400 lb. The endurance

package is located completely behind the two-place cockpit. Fuelage and wing are of bonded light metal and built construction with laminar flow.

Maximum speed of initial production version will be about the Mach 3 to Mach 4 range, but ultimate design specifications call for Mach 6.

The straight wing has a span of 95 ft and its aspect ratio of 20.

General Dynamics Will Retain Convair Name

Retention of the Convair name, at least for its commercial aircraft, is planned by General Dynamics Corp., and it has changed the two names of the former Convair San Diego division to provide for this.

In the reorganization involving the former Convair Division (AWN 35, p. 45) General Dynamics had acquired the San Diego operations General Dynamics/San Diego. Since then, the name has been altered to General Dynamics/Convair.

The Convair name may also be used to identify aircraft and related design tools, but the corporation hopes, as this has not been formulated yet.

Heads of four former divisions of

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The Model 140 Simulator consists of three hydraulically driven gas-beds that translate computer air input signals—error voltages (rate, roll, pitch, and yaw positions, velocities, and accelerations) by means of a position-feedback servo system. One of the most important features of the Model 140 Flight Simulator is the extremely high ratio of maximum to minimum, smooth, controlled rates.

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Partners in Automated Testing

Corporation have been awarded contracts of the new General Dynamics Division and various new products in the region. They are:

- J. B. Decker, General Dynamics/Aerodynamics
- Charles E. Hesse, General Dynamics/Physics
- Frank W. Davis, General Dynamics/IT-Work
- Robert C. Lucas, General Dynamics/Control

All were former Convair vice presidents. In fact, one notes, they spent 10 to 15 years at Convair, General Dynamics' predecessor, vice president in charge of the vehicle business.

Other changes include appointment of Robert D. Brien, former vice president-administration for the Convair Division, as corporate vice president-in-charge of the vehicle business, and Ron R. Brown, director of government accounting, Chester L. Mosler, director of research, and Stanley R. G. Hillman, director of material R&D, corporate-wide positions in San Diego.

PRODUCTION BRIEFING

North American Aviation Space and Information Systems Division has a 13-month Air Force study contract to improve optical satellite observation and prediction techniques.

Confinement Corp. has awarded its propulsion subsystems under the direction of the Wright Aeronautical Division, Wright-Patterson, N.Y. Purpose of the award is to coordinate propulsion and development programs.

Kinetic AFB, Mich., became the first site to be equipped with Boeing Boeing B-57D-100 aircraft earlier this month.

Federal Aviation Agency used type certificates for the Pratt & Whitney JT3D-2 turbofan engine and the JT3D-2 engine. The JT3D-2 is a modified version of the previously certified JT3D-1.

Donner Engineering Corp., Cambridge, Mass. has received a \$100,000 contract from USAF's Ballistic Missile Development Center for equipment to test extremely accurate processes in missile metal guidance systems.

Wallace Laboratories of Sylva, Electric Products, Inc., Wilkes-Barre, Pa., a subsidiary of General Telephone & Electric Corp., has received a multi-million dollar contract from the Bell Telephone Laboratories for the development of an advanced order design for possible future equipment with the U.S. Army's Nike Zeus anti-missile missile system.

ITT Federal Laboratories, Ft. Wayne, Ind. has received a USAF contract to study possible designs of automatic, standardized equipment for testing and checking out inertial guidance systems under the Air Force's new Project VANE (variable automatic test equipment) which has in its objective the standardization and automation of USAF missile test equipment.

Kellogg Instrument Corp., Standard Kellogg Industries, Chicago, Ill., has been selected by General Electric Co. to develop and manufacture test systems for a series of three Orbiter, by Instrument Observatory (IOM) spacecraft now being built by General Aircraft Engineering Corp. for a scheduled launching in 1963-64.

F. I. de Paul & Associates and Co., Wilmington, Del. has received a \$5 million contract from USAF for research and development work in the field of high-energy radar systems. Research will be conducted at de Paul's Entree Laboratory, Glenview, N.J., for the Air Force Flight Test Center, USAF Systems Command, Edwards AFB, Calif.

General Electric's Flight Propulsion Laboratories Dept. has been granted a \$50,000 contract by NASA for a study on chemical space power generators. Contract covers study of turbines for use with nuclear turbo-generators system. The test transfer characteristics of turbine working fluids for the various gas circuits being studied by the GE laboratories under an earlier NASA contract.

Paul D. Jett Co. of Lakeland, Fla., has been awarded a \$27,745 contract by Army Corps of Engineers to install 64,000 volt power lines at Complex 15, the former National Aeronautics and Space Administration Service pad.

Avco Corp.'s Nashville Division, Tenn., will build components for 15 additional Convair 990 jet transport under a \$6-million contract from General Dynamics. The subcontract production includes control and instrument subunits, elevator rollers and wing-shaped leading edges and outboard trailing edges.

Automation Industries Inc.'s Research Division, Manhattan Beach, Calif., will assemble ultrasonic methods to inspect complete sub-propellant assemblies after delivery from Ingersoll and launching sites under a \$175,000 R&D contract awarded by Navy's BuAid through Hercules Powder Co. The program runs through 1961 and is continued presently with a Phase 2 Study.

THE AIRSEARCH GULFSTREAM COMPLETION PROGRAM

This extensive completion program at AirResearch Aviation Service for Grumman's new prop-jet cargo plane transport includes: control systems, interior... soundproofing... exhaust... cabin... cockpit... instrumentation... paint... maintenance.

AirResearch personnel have been busy testing for this special program. Expert craftsmen utilize the best materials and processes in building and testing light aircraft, fully stressed furniture, loupes, pylons, lavatories and other appointments custom designed for the individual Gulfstream purchaser.

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SCIENTISTS AND ENGINEERS:

Follow-On Atlas Programs Mean New, Long-Range Opportunities.

Now operational, the Atlas weapon system stands as a unique symbol of scientific, engineering and military achievement. The design, development and testing of this reliable missile was an undertaking of immense complexity. Scientists and engineers at Convair/Astronautics worked constantly at the most advanced state of the various arts involved. Reliability, they introduced and proved entirely new concepts of reliability, and in recent times they developed the Atlas.

The same depth of imagination and technical daring is now at work modifying and adapting this sophisticated machine for a variety of civilian and military space missions. Dozens of specialized orbiting and inter-planetary vehicles will depend upon the power of Atlas to thrust them into space. These progress such far into the future and require the skills of highly resourceful engineers and scientists in many technical disciplines.

Atlas is the free world's first intercontinental ballistic missile; the first missile to travel more than 9,000 miles across

the earth's surface, the only one to lift itself into orbit. Atlas marked the first use of solid engines for directional control and it was the first to use airframe skin as fuel cells. Many more "firsts" lie ahead for this reliable rocket. If you are the sort of inventive engineer or scientist who can contribute ideas and solutions to the problems surrounding the mastery of space, you and Convair/Astronautics have a common interest.

You'll find most of the details on this and the following page, plus a convenient inquiry card. If the card has been returned, or if you wish to furnish or request more detailed information, write to Mr. R. M. Smith, Industrial Relations Administrator-Engineering, Mail Zone 180-86, Convair/Astronautics, 3637 Kearny Villa Road, San Diego 12, Calif. If you live in the New York area, please contact T. C. Cline, manager of our New York Placement Office, 1 Rockefeller Plaza, Circle 3-5024.)

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RELIABILITY: BSEE, ME, or AE to perform reliability analysis and test both in San Diego and offsite boxes.

PERSONNEL SYSTEMS (MAN/MACHINE ANALYSIS) Specialist capable of evaluating the personnel function from a systems standpoint. Requires analytical approach to applying manpower to an existing system at the customer level. Broad technical systems background with emphasis on human relations is essential. Assignments involve analysis of manpower requirements and applications for a weapon system, including assessment, procedures, time studies, load-

tics and training. Degree required, preferably in industrial engineering, business administration or industrial psychology.

ENGINEERING WRITERS with 2 years college and 3 years experience in preparation of TCTD's, Operations, Maintenance and Overhaul manuals.

BASE ACTIVATION: Design or liaison engineers with BS in ME or EE and experience in electrical or mechanical systems are required for liaison work at missile launching complexes, or design support work on launch control equipment, propulsion systems, automatic programming and missile electrical equipment operations. Assignments are at Salina, Kansas, Lincoln, Nebraska, Alton, Oklahoma, and Abilene, Texas. Also some openings in San Diego.

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CONVAIR GENERAL DYNAMICS

MANAGEMENT

Defense Is Evolving New Weapon Plans

By Craig Lecht

raised unarmoured bomber down through the 1960's with increased emphasis on solid propellant rockets. It is indicated that Defense is conducting a long-endurance, subsonic alternative to the North American Mach 3 B70 as the forward bomber for the late part of the decade and is not doubt on the development of any new strategic ballistic missile system unless there is a "demonstrable" breakthrough in solid fuel technology.

Muhammad Basit

Boeing B-52s and Convair B-58s, along with the penetration aids already developed or planned, are the only nuclear bombers currently proposed for the rapid tempo and they are likely to remain in service through the end of the decade. Defense does not "personally plan" to buy any more of these bombers even though Congress has authorized further production, Gilmore said.

But he left the door open for a change. "I use the words 'possibly plan' advisedly, future events might change the plan," he said.

Galperin also noted that "for the next few years, at least" there is con-

sideable flexibility inherent in the still sizable Boeing B-47 force. Both the Eisenhower and Kennedy Administrations have juggled the planned phase-out schedule for this bomber to retain strategic power in critical periods.

Explaining Defense Department's approach to the B-70 program, Gilpatric noted that aircraft development will continue in effect, "having an option" to full B-70 weapon system development for \$1.3 billion instead of the estimated \$2.7 billion needed in one complete weapon system development program.

This approach preserves freedom of action for Defense and does not court what it "seeks to bulwark" against as we know them today. Gilpin and the department will continue to welcome any new concepts for strategic delivery systems that promise improvement in military methods. But he warned:

The acceptance of new concepts for production and for introduction in the invention of deployed systems is not, however, a decision based on cost and effectiveness comparisons of the current systems that might be applied to the mission during the same time period. Furthermore, these con-



B-58 Tests Downward-Ejection Escape Capsule

8-52 with modified escape routes and, new, outcropping downward-sloping trails lead to Covered Dynamics/WT. Work item: Upon completion of downward- and upward-sloping trails all 8-52s will be equipped with escape routes designed to protect crewmen from weather and wind blown debris strikes up to and beyond March 1.

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effectiveness comparisons must be made with full accounting of such factors as the lack of a nose in a half-size missile.

Among approaches considered for future missile systems, Gelpi said, are: increased low-level penetration ability, as improved high-lift-to-drag booster and an aerodynamic-type vehicle in the modified structure. Missions: maneuverable space vehicles are not beyond possibilities.

In the next period, he said, it is to be expected, he pointed out that a "stand-off" booster could be developed. This could be a long-range, long-endurance vehicle launching platforms carrying an advanced no-is-a-missile missile of the Stand-off type.

This is similar to the Domesday concept proposed several years ago. It would probably evolve as a sub-orbital aircraft with endurance ranging up to two days, and it might have the flexibility to perform defense functions (JAW June 12, p. 260).

Anyone concerned and control point are a requirement, but Gelpi said this need probably can be met by adopting a transport to a stand-off booster type.

Domesday is being accelerated in development as a research vehicle, but Gelpi said that it has not been recognized beyond the first phase and that "it is unclear at this time whether

Domesday will ever be reduced to a military weapon system."

The planned 10-year-old ASAP, Comco Atlas and advanced 124-quadron USAF/Martin Titan program will be completed, but Gelpi said it is clear that solid fuel missiles—particularly the Northrop-Lockheed Polaris and USAF Boeing Minuteman—hold higher interest for the new Administration. He said efforts to improve their performance will continue and "for a somewhat lower priority, we also look forward to some improvement in the Titan II weapon system." Titan II also is to be used in the space program.

Missile, Space Market

"Unless we can achieve a dramatic breakthrough in a solid fuel element—and this is a possibility which should not be excluded—it is difficult to visualize an entirely new strategic ballistic missile development in the near future," Gelpi said. "As you have heard, there has been a lot of talk about a mid-range, land-based tactical ballistic missile, for which there is no war, however, a firm requirement."

These new also develop a future requirement for a mid-range, land-based ballistic missile—perhaps other Polaris or some new solid fuel missile, but it would have to have a much better cost effectiveness ratio than the proposed

modification of the Polaris in the medium-range cruise Long Beach," he said.

Gelpi said that space projects and their related supporting programs already amount to about \$1.1 billion in the fiscal 1962 defense budget, and "we can, with perfect timing, the amounts allocated to these projects in the future will be even greater. Taken together with the anticipated increases in the budgets of other agencies, particularly NASA, the space program is clearly destined to become a major market for the aerospace industries."

Major new elements of the military space effort are the Air Force solid booster program and the efforts to develop a new high-energy upper stage for Titan II to provide a backup vehicle for Atlas-Centaur and its other payload vehicles. Gelpi said that the large solid booster program is directly related to the national space program, but he said that "we are not sure that it will open up a new technology for eventual military applications."

With 200 in its portfolio in research and development, a phase of the program scheduled to cost about \$1.75 billion. Despite the uncertainty involved in projecting a production program, Defense Department feels it does not have a sound basis on which to decide now. More advanced missile defense

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Grumman Shows A2F's Conventional Weapon Armament

Two-place carrierhead Growlers AIF low-level attack bomber designed for nuclear or conventional weapons displays its conventional armament of Area 70 ordnance launchers with 75 rockets (front row, short capacity), four LAU-6A packages of four 5-in. Zuni (front row, long capacity), Mk. 51 1,000-lb. and Mk. 54 2,000-lb. bombs. In the rear (white) are ADM-74 Bullpup missiles and under the wing in clusters of three are 500-lb. bombs.

studies are continuing under Project Defender at a current spending rate of over \$100 million a year.

Gilpatre stressed the new Postage policy of using the 15-service cap on developing new aircraft (AW June 13, p. 36). "We have no choice but to adhere to a practical minimum: the number of different types of tactical aircraft we undertake to develop and produce," he said.

Gilpatric conceded that it might be impossible to design a single aircraft to cover all the tactical needs of the services, but he said it should be possible to develop one aircraft for all roles.

the business. Thus the business fighter now in the planning stage should be able to perform an up-to-date, consistent and comprehensive sales for all the services it can be made compatible with current operations.

A second tactical fighter might be required for the close support and light attack role, he said. "provided this aircraft is needed in large numbers and can be produced considerably more cheaply than the larger and more sophisticated fighter."

Observing that inner-city and urban environments are "poorly well in hand" with the safety for C-100s and C-110s and development of the C-111, Gold put a hot line and "cold" was recommended for development of vehicles to improve local air mobility. Here again, the in-service approach will be used to reduce the number of different vehicles involved, especially for business.

A in-service VTOL transport program already is under way in the Air Force. Gagliardi noted that this represents a step toward advancing the state of the art beyond the helicopter, which is "a vehicle of essentially limited effectiveness—very expensive and difficult to maintain." He said the in-service VTOL aircraft should not purchase their way about other more solid concepts.

There will most certainly continue to be a need for rugged-and simple-to-maintain are vehicles which are capable of operating from complex, rugged terrain fields and in primitive conditions, such as, the end of long rough, low and without otherwise local logistical support. Such vehicles would be extremely useful in the kind of limited war situations we are most likely to encounter in the years ahead," he said.

Proposed Influenza

"Equally important, the successful development of such vehicles could cast a profound influence on our present tactical doctrine. And we still need some new tactical doctrines if we are to successfully cope with the new tactics adopted by our adversaries."

Gen. Jack D. Edmister, Army vice chief of staff, told the conference that the Army needs a 3-4-ton capacity VTOL or STOL replacement for the Boeing-Vertol Chinook helicopters and the Hamilton County STOL transport used to be in service. He and the transport VTOL could do this work, but a pig would still remain between such a VTOL transport and the Lockheed C-130.

To fill this gap, the Army would like to have a "true assault transport" with a 10-12-ton payload that could support force units on all terrain in combat environments.

and a 1632-ton capacity VTOL, critical to carry equipment on short trips across such obstacles as rivers, swamps, jungles or mountains.

Carpenter noted the state's cost-price reimbursement type contracting began less than 10% when he served as assistant secretary in the Air Force in 1951 to nearly 45% of current procurement. Whatever the reason for the trend, he said the fact remains that "cost-plus-incentive-fee contracts weaken the incentive for contractors to place increased responsibility for close surveillance over costs, not only on our contract administration but on industry management as well. We simply cannot do the whole job in the Defense Directorate."

It is the final authors' hope that the large part of the job rests with management. In the industry, you are the ones who actually spend the money. What we can and should do is to work out a practical, acceptable system for rewarding good cost performance through bonus/profit incentives, while punishing substandard performance through reductions in profits or loss," he said.

Carpenter also expressed concern over the problem of conspicuous-conspicuousness in formal advertising, sales-force recruitment and other areas. He said in an analysis of contract awards in the last six months of 1990 showed that 60% in dollar value involved no competitors, including 25% for sole source procurement and 35% for follow-on contracts after initial contracts were awarded competitively.

Congress and the public are highly suspicious of non-competitive procurement by road, and we must do everything possible to assure competitiveness, regardless of whether the procurement is made through formal advertising or

nozzle spray patterns tell a story of performance

by William F. Friedman, Jr.

As the Air Force and NASA continue to develop new aircraft, the need for more efficient and reliable engine components is becoming increasingly important. One of the key areas of research is the development of new nozzle spray patterns that can improve engine performance and reduce emissions. This is a highly demanding task, requiring the use of advanced design and manufacturing techniques. The Air Force and NASA are working closely together to develop new nozzle spray patterns that can meet these challenges. The results of this research will be used to develop new aircraft engines that are more efficient and reliable than those currently in use.

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though negative." He pointed out that the services have been told that it is not possible to define requirements and shift funds well in advance of contracting, to provide technical data in only as portable and to perform specifications in a timely manner.

The Armed Services Procurement Office has been changed to require that most defense procurement, whether finally selected or rejected, be published through the Commerce Department.

USAF Assistant Secretary for Material Joseph J. Jones told the AIA, however, that it is an Air Force trend toward "package" programs, highlighted by formation of Air Force Systems Command, and that he sees a major implication for industry in that.

Under Mr. McNamara's and Mr. Rusk's philosophy of assembling one-way and program packages, one-way package programs becomes a critical element. It goes without saying that the accuracy and validity of the data, cost estimates and cost performance, safety and test performance and knowledge of obtaining reliability will decrease to a lesser degree whether there is a feasible or non-feasible decision in the highest level for various jobs of the program.

"I am aware that that, once approved for implementation, each of these package programs will undergo continued surveillance for reduction of costs," he said.

Jones observed that while USAF has been the most vocal service in urging the merits of the systems management approach for large, complex programs, the Navy has come much closer to the "dream" with the Polaris program. He said the Polaris management technique has become almost a government standard. The PERT technique, later adopted by USAF, the National Aeronautics and Space Administration and several companies was developed in the Polaris program.

"In my opinion," Jones said, "this is a breakdown of a continuing way of life by the foreseeable future. The decision and problem originating from the secretary of defense's office directly indicates an intent to obtain greater sophistication of the systems management concept."

Reviewing the background for the recent Air Force reorganization which produced the Air Force Systems Command and Air Force Logistics Command, Jones said that studies made over the years had made minor, relatively insignificant improvements in the management system for developing new systems.

Two years ago, a top-level study group was formed and spent a year reviewing the situation. It considered but did not recommend major changes



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in functions and requirements. Inevitably, the study largely produced a revised and detailed series of regulations for conducting USAF system acquisitions.

Shortly after Dave Zuckert took over as secretary, he and the chief of staff, Timmy White, decided to face squarely the organizational problems in the SDA, he said. "Then did. On March 17 the reorganization was announced for effectivity on April 1 with all changes to be completed by July 1, 1961.

"I ought to add that Mr. McNamara's decision to study SDA to stage the major system development activities for the Air Force probably expedited the reorganization action.

In industry, Ingersoll feels it is significant that very few people will be moved in the process of the reorganization. Companies will continue doing business with existing government and contract administration offices—they will simply be switching to AFSC rather than the logistics command.

AFSC acquisitions cover advanced technology, test, procurement, production, contract management and life activities. Their functions are to be performed from the new USAF issues a requirement until the last cent is delivered from the production line. Thus, industry involvement will deal primarily

with a single authoritative source.

Ingersoll and Systems Program Director will be given maximum authority and responsibility and will be the primary contact point for the Air Force on individual systems.

During the acquisition phase, AFSC will budget for and buy all items required for a system. USAF plans to use the "Systems Package Program," under AFSC component contracts, as the "single authority integrated planning, programming and implementation document for systems proposals, acquisition, training, operation and support," he said.

Logistics command is to be responsible for logistic support planning, policies and control. It will determine how much support equipment, spare parts, ground equipment and personnel. Forwarded equipment will be sent by a system, and it will purchase replacement equipment, spares and services.

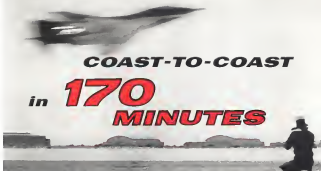
Ingersoll said that industry will have no contractual contracts with AFSC through the Systems Program Office while a system is in the acquisition phase. The SPO will have representatives from logistics command and the appropriate operating command. He said the Logistic Support Manager concept will be retained, and "during the operational phase of any system, some small contacts will be with the AFMs and depots."

Financial Briefs

Westinghouse Air Brake Co., announced last quarter 1961 consolidated sales were \$18,948,874 compared with sales of \$16,757,165—a 13% decrease from 1960 first quarter sales. Earnings were \$1,188,818 compared with \$1,904,273 for the same period last year. Net income after taxes was \$1,027,511 for the 1961 quarter or 39 cents per share on 2,635,961 shares of stock authorized and compared with last year's first quarter net income of \$1,085,817 or 40 cents a share on 2,635,765 shares outstanding.

International Rectifier Corp., reported sales for the third month ended May 31, 1961, of \$18,761,375 compared with \$9,914,136 for the same period in 1960. Net income after taxes was \$923,201 or 35.5 cents a share on 2,605,994 shares outstanding. This compares with \$928,241 or 35.4 cents a share for an equal number of shares in the same period in 1960.

Lucas, Inc., sales for the first three months ending May 31, 1961, were \$743,154,697 compared with last year's first quarter sales of \$723,816,137. Net earnings for the current quarter were \$184,516 or 21 cents a share on 2,779,253 shares outstanding.

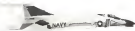


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Crossing the continent at the rate of a mile every four seconds, Navy Pilot Lt. R. F. Gordon and Radar Intercept Officer Lt. Jg D. R. Young flew a McDonnell Phantom II from Los Angeles to New York in two hours, 48 minutes, 44 seconds on May 24, 1961 to win the Bendix Trophy Race and establish a new record for the distance.

The record was set minutes earlier by Lt. Commander L. S. Lemeroux and Lt. T. J. Johnson in another Phantom II. Their record was two hours, 58 minutes, 19 seconds.

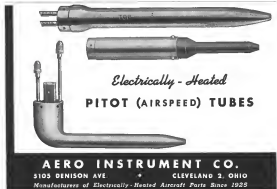
The lead crew, Commander J. S. Lake and Lt. Jg E. Cowart flashed over New York in their Phantom II even before the other two to break a three-year old record established by an Air Force RF-101 Voodoo, also built by McDonnell. In all, the last seven west-to-east transcontinental speed records were set by pilots flying aircraft built by McDonnell. The Navy's carrier-based all-weather Phantom II also holds the world's 109 kilometer and 500 kilometer closed course records. Setting these distance and maneuvering records requires a very high straight-line speed capability. Security permits only the statement that maximum dash speed for the Phantom II is "in excess of 1560 mph."



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Jet Thrustmeter

Thrustmeter, based on exhaust static pressure, measures gross thrust of jet and rocket engines, both in flight and on the ground.

The thrust measuring system incorporates a computer, pressure-mounted indicator and a potentiometer in the exhaust duct. Cross throat is compensated from total pressure on the at least side and ambient pressure from the static system or other source. Total mass in thrust indicator is said to be within 1% of full scale. System weighs 12 lb.; power consumption 30 watts, 400 cps, 115 v.a.c.

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BUSINESS FLYING



POTEZ-HUMBERT CM 90, follow-on from the Magister jet trainer, is shown at Paris in executive interior fittings. Canopy slides forward.

European, U.S. Business Planes Vie in Paris



BOLKOW F.207 executes a slow flight demonstration at Paris. Note large tail wheel with photo bracing. Gerdas G283 (right) is new French lightplane powered by a 150-hp Lycoming O-323 engine but can take a 160-hp Lycoming O-333.



DOMINANT FEATURE of the Mooney-Saabster Super Rallye is the large leading edge that for high lift characteristics. Control wheels (right) in Super Rallye can be stowed in spread position for easy entry and exit.



UNUSUAL SPEED BRAKE extends from Pacer F-400 Collet's center fuselage, shown locking after Paris Air Show demonstration.

Flight Display

By Herbert J. Coleman

Paris-Europe's lightplane builders noted their top aircraft to the Paris Air Show descended to back, troubled U.S. business aircraft market and, in the flight demonstrations at least, succeeded.

It was in the phrase of the show that the European designs took the spotlight from the U.S. light planes, particularly the Lancair Model Comac and Pacer lines. The light twins were considered to competitors' single-engine low-propeller aircraft but the Europeans concentrated on high performance in a limited field of view.

The European plane flew with such vigor that a dozen or so were warned to clear and desert by the show management, and one Italian pilot, Gerdas Gerdas, was not allowed to fly the Mach 120 two-place jet trainer in the final day's flying display.

Gerdas, who pulled more than four negative g during inverted displays at low altitudes near the crowd, took a typically continental attitude at his banishment from the show. "It is the loss of the Pacer," he thought.

The Mach 120, the Pacer F-400 Collet and the Mooney-Saabster Paris II stood out in the jet demonstrations, but considerable interest was shown in other new jets on static display. They were: • Mooney-Saabster Paris III, called the NS-700C, shown for the first time in mockup form. Essentially a Paris II, the airplane's dominant change is the five-seat cabin with a side door in the port side added to replace the Paris II's side entry. Entry seat is instead at the aft cabin and baggage area is provided in either side of this seat. Baggage area can be increased by folding



CZECH ZLIN 226, flown by Zdenek Vlcek, shows its 40-inch wingover after inverted climb.



ROCKAW JUNKIE was first developed in the Andromen Mk.7 by Czech engineers. Note also that "Controlled control stick" at Rockaw Junkie (right) is small, but company pilots say it is simple to get used to. Shoulder strap is used in a control lock. Stick was ordered in order to provide added mass in the cockpit of the aircraft.

the 6th's air-bank. Performance is similar to that of the Fiat 11. The plane is sold in the U.S. by Beech Aircraft.

• **SAAB 105** brought high-wing aircraft down to the show in a different form, a contender for the two-place civil and military market. It is based at Linköping, Sweden, with company headquarters at U.S. Civil Air Registration Part 1 for stable and accurate configuration. The wing spans 32 ft, 2 in., wing is of composite design. The cabin is pressurized and pilots are seated ahead of the wing. Two Turbomeca diesel engines of about 1,000 hp thrust are planned. Turbomeca did not display the engines at the show. Turb engines would be hung on pods below the wing, with the thrust line passing under the T-tail. In the utility version, the SAAB 105 has a gross weight of 5,100 lb., a thrust load factor of 5.5 and a maximum

load factor of 5.0. Maximum cruise speed is 490 mph, cruise climb is 790 mph, and range at the latter speed is 1,400 stat mi. Fuel capacity is 170 gal. carried in integral wing and fuselage tanks.

• **Pitts-Bledel CM 101** prototype, scheduled for first flight in August or September, was mounted in the nose section in a diving trim position (AW May 29 p. 12). Built for Lockheed Flugzeugbau, the CM 101 is a follow-on to the Peter-Bledel Magister research trainer. This version has four seats in civil interior design, and is aimed at oceanic and borderline operations at a cost of \$220,000. Airplane is all-metal with cruciform wings and combined V-shaped rubber-covered tail unit. Trapped tail wings in emergency configuration have thrust data and engine. Four-type flap. Speed brakes are installed in upper and lower wing surfaces. Landing construction is of oval fuselage connected by four bogies.

Range can be increased to 1,600 mi (about 5 hr endurance) by installing auxiliary tanks in place of the two main ones.

The Mach 125 two-place jet which was based from the dual living demonstration is one of 10 airplanes completed in a 70 plane order by the Italian Air Force. Powerplant is the Bristol Siddeley Viper 11, but its spent version, the M1-30, is now undergoing operational experience in a 125 (AW May 28 p. 74).

Mach 125 is building the Lockheed Martin-Siemens M125, an EASA 68 model, and plans a 15 per month production schedule. First production airplane was shown at Paris and the company has initial orders for 50 in the Mediterranean area. It also will be shown in Great Britain where a housing company has shown some interest in taking another 10 planes. Powerplant is a Continental KI-470 of 360 hp. Lockheed's office in Geneva, Switzerland, is



NOISYUP of Dassault Mirage three-engine aircraft was leading pace for night field operation. Plane is designed for day and night. Dassault Mirage (center right) was fitted with night control for pilot but can be equipped with dual controls. Horizontal and vertical beam emitters are in order position. Thrusts and reverse controls are long from ceiling.



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helping Maché in sales promotion. Price in Italy is about \$21,000.
Italian designer Stelio Frati's Project F-450 Cefusa prototype made its first public showing here since testing on its Italian testbeds last May 20. The plane is powered by a Turbomeca Marston II turbine and the design includes a slotted speed brake which drops below the cruise fuselage at the wing root position. Plane has a speed at takeoff of 180 mph and price will be in the neighborhood of \$50,000. Production launch is scheduled for next September.

In the mid-air safety field, North American flew its 737-100 (see Aviation Week pilot report June 5, p. 74) and will demonstrate it further in Europe to spread out its civil airliner. The plane showed a high degree of maneuverability, pilots Art DeHolt and Bob Finn noted the 737 as the first day's flyer but commented the roll the aerobics, following the Coast B-57 crash (AW June 14, p. 24).

A Carabodanville pilot, Boris Virek, walked off with the popular banner as a 150-lb. Walter Martin, Novot of the French helicopter the Gaudin GEF 66, an aircraft, lost plane (AW May 28, p. 21), was declared in transit to the show he showed earlier and did not participate. The GEF 66, owned by Gaudin, is built by Avion Yvon Gaudin in cooperation with Huel Dahan which is providing facilities and some technical support. The prototype was made a U.S. aircraft in cooperation with interest in U.S. airlines and also rights.

U.S. rights to two other popular French models, the Moneo-Senker MB-100, Roloff and MB-100 Super Roloff, are now being negotiated with Caltech Aircraft Corp., Modesto, Mich. Both Roloffs participated in the flight demonstration, in formation and single. Model features a slatted automatic leading edge slat for high lift, and the wide span slatted flap. Moneo-Senker and No. 4 prototype will test the U.S. for take-up. Production will reach 30 per month this fall.

New Man Helio project in the Broadmoor Major is a two-engine development test shown at partial workshop and now being built for first flight next spring. Post-flight are two 110-hp Continental C40-770. Gross weight is 1,950 lb. Dimensions are

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DENSITY OF LIQUID B₂H₆ vs TEMPERATURE

Temp. (°C)	Observed Density (g/cm ³)
40	0.5566
70	0.5760
78	0.5761
88	0.5668
98	0.5608
100	0.5594
100	0.5522
115	0.5411
123	0.5389

SOLUBILITY OF NITROGEN IN LIQUID B₂H₆ (Total Pressure 1000 in 7 mm)

Temp. (°C)	B ₂ H ₆ (g/g)	N ₂ (g/g)
30	48.7	0.0118
50	48.4	0.0407
70	47.9	0.0407
90	48.0	0.0711
100	47.8	0.0722
115	46.6	0.0779

(1) GLEP, and Gas Period Pressure (mm. Hg)
(2) B₂H₆ is water and water pentaborane
(3) B₂H₆ is H₂O/GP

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Cherokee Fills Role as Tri-Pacer Heir

By Andy Kell

New York—Stability, economical cruise performance and docile stall characteristics have been developed and combined into the low-wing Cherokee by Piper Aircraft Corp. to make it a successful replacement for the low-cost Tri-Pacer.

The Model PA-28 Cherokee is now in quantity production at Piper's new Vero Beach, Fla., plant and test deliveries began this month.

With its slightly dihedral wing, swept-back tail and tricycle gear, the Cherokee (AW 100, p. 180) greatly resembles the larger, higher-powered, retractable-gear Cessna 441.

Glass Fiber Structures

While primarily off-land, the Cherokee's nose and wing tips, stabilizers, fins and radials are of glass fiber. Piper's method of simplifying construction problems and reducing costs.

The four-place aircraft, with its 74 in.-dia. Rotax 440-hp radial engine, can be equipped with either the 150 or 160-hp Lycoming engines. With the 159-hp engine the Cherokee weighs 2,150 lb. with an empty weight of 1,891 lb. and a useful load of 955 lb. The 160-hp engine plane weighs 2,200 lb., has an empty weight of 1,195 lb. and a useful load of 1,065 lb. Both models have a standard capacity of 36 gal and a maximum capacity of 50 gal.

The wing is an NACA 63-415 airfoil section with a span of 30 ft. and an area of 190 sq. ft. It has a 7-deg dihedral angle and a leading edge of 13.4 to 13.5 gal. Slotted flaps, controlled by a handle between the front seats, cover 14.6 sq. ft. of wing area and can be lowered to 15, 15 and 48 deg.

The 27.5-ft.-long aircraft stands 7.5 ft. high as its tricycle nose-actuable gear. The main wheels have a load of 10 lb. and are controlled by hydraulic brakes operated by a single control lever accessible to either front seat occupant. The steerable nose wheel, linked to the rudder pedals, has a turning radius of 18 deg. in either direction. The cabin is entered via a right wing walk-up. Accommodations are adequately roomy with adjustable front seats and available seat belt which increases the use of the 19-cu-ft luggage compartment to 46 cu. ft. Baggage can be loaded through a separate outside door aft of the cabin door and convenient from the ground.

All flight instruments are located in front of the pilot's position, and engine gauges the center panel, and engine



CHEROKEE has cost Piper's Vero Beach, Fla., manufacturing facility where the low-wing, four-seater, all-metal aircraft are being built.



FLIGHT INSTRUMENTS in Cherokee, including full gyro panel, are located to left side, radio in center and engine instrumentation to right in instrument panel.

instruments are located to the right of the full instrument panel.

Aviation Week's evaluation was made on a cross-country flight in aircraft number N1801W, the fourth Cherokee and second production model to leave the production line. The Super Cessna 160 by Cherokee was being formed to the Piper Lock Haven, Pa., facility.

Takeoff was from Fitchburg Airport, N.Y., with gains of 33 to 37.5 and climb of approximately 2,750 ft. An

was isolated on route with ceiling rising westward to a height of 5,000 ft. over Lock Haven. Intermediate stops were made at Mansfield, N.J., to pick up another passenger, and at Williamsport, Pa.

With master and fuel pump switches on, the mild Lycoming engine started with a push of the starter button and with relatively few turns of the propeller.

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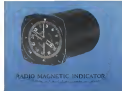
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demonstrated the extremely quick climb and short turn radius of the aircraft was noted. The climb rate of the Cherokee 810 was 1,000 ft/min. The Cherokee 810 was noted to climb at a rate of approximately 1,000 ft/min. The climb rate of the Cherokee 810 was 1,000 ft/min. The climb rate of the Cherokee 810 was 1,000 ft/min.

Turning into position after a series of turns, the Cherokee 810 was noted to turn at a rate of approximately 1,000 ft/min. The turn rate of the Cherokee 810 was 1,000 ft/min. The turn rate of the Cherokee 810 was 1,000 ft/min.

In all tests, the Cherokee 810 was noted to turn at a rate of approximately 1,000 ft/min. The turn rate of the Cherokee 810 was 1,000 ft/min. The turn rate of the Cherokee 810 was 1,000 ft/min.

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WHO'S WHERE

(Continued from page 21)

Honors and Election

Joseph A. Willey, engineer test pilot for the National Aeronautics and Space Administration, has been named the recipient of the Institute of the Aerospace Sciences 1981 Oestre Chausse Award "for exceptional flight testing of and engineering contributions to high-speed flight research programs including the X-1 through X-15."

Mr Sydney Croom, director and chief engineer of Hawker Aircraft Ltd., and J. D. South, chairman and managing director of Boulton Paul Aircraft Ltd., were honoured to receive the following awards at the Royal Aeronautical Society. The Society will also present the following awards at the Wilbur Wright Memorial Lecture, Sept. 12: Honorary Fellowship to J. N. Toothill, director of Farnborough Ltd. Refuelling Ltd., and granted members of Farnborough Ltd. Edinburgh, The Silver Medal to

Indies, followed director (consult) of Wulfand Azzurri Ltd, for his superb eye work in the design and development of water-wang events. The Broomfield is L. Howard, assistant chief engineer, poppet valves of Ralls Ropes Ltd. "For his work leading to advances in aircraft gas turbine design." The Bermuda Gold Medal for Achievement is Dr. S. G. Hoadley, technical director (area) of Royal Society, England Ltd, "for his outstanding personal achievement in water-wang design and development."

development in villages, towns and the countryside'. The British Silver Medal for Achievement in Public Service, bestowed on him by King George VI, 'for his personal achievement in aircraft design, with special reference to his development of the now standard configuration'. The Bristol Gold Medal in D. E. Eggeson, director of research of Marconi's Wireless Telegraph Co. Ltd 'for his contribution to the safety by the development of air traffic control and no collision rule'. The R. P. Miles Medal in R. E. Thompson, superintendent

of Airplane and Airman's Experimental Endowment. "The big practical achievement in the creation and direction of flight test observation staff." The N.E. Rotor Model, awarded for the best lecture given to any branch of the society by a member of a branch, to J. Williams, Chester Branch, and W. Stokes, Brough Branch. The Allen Marsh Model to Jack Beaumont, a Rovers Helicopters, Ltd., pilot. The best presentation of an original oil-pan from the

at-shore drilling rig ... Jan. 28, 1987.
The Alan Marsh Award awarded to a
British geologist who has shown exceptional
ability in geological study in the north, was
held to Mr. S. Baker, who will arrive in
Southwest Wales Division of Woodhead on
July 1987.

Chances

Cdr Paul Hunter Bickel (USN, ret), reports coordinator, Seabird Association.

Gilbert M. Edelmann, awarded for his pioneering in the use of pendulum of sales. *Register*

Carl R. Wetters, assistant chief eng
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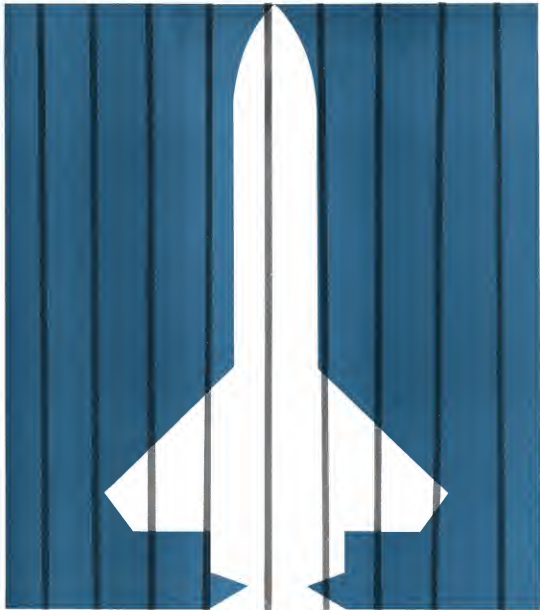
The successful execution of these programs requires extensive research efforts of a basic nature in the areas of efficient navigation and the guidance and control of vehicles operating far out in space. The problem areas being investigated include novel concepts in navigation based on astrophysical phenomena as well as research on inertial, optical, and electro optical sensors of various types.

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CM-122/DSM Signal Comparator



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